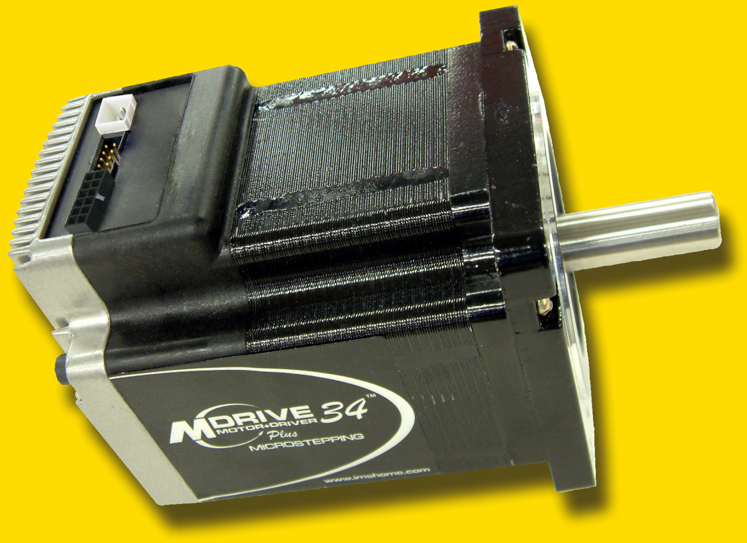
MDrive34Plus
Microstepping
Integrated Motor and Driver

MDRIVE™ MOTOR+DRIVER Plus



IMS™ INTELLIGENT MOTION SYSTEMS, INC.

by Schneider Electric

MDrive34Plus Microstepping Hardware Reference Change Log		
Date	Revision	Changes
06/26/2006	R062606	Initial Release
03/12/2007	R031207	Changed Max Step Clock rate to 5 MHz, Min Pulse width to 100 ns, default input filter to 2.5 MHz (50 ns). Changed temperature spec to -0 to +75°C (non-condensing humidity, measured at the heat sink) and -0 to +90°C (non-condensing humidity, measured at the motor.) Added Section 2.1: Mounting and Interface Guidelines and Section 2.2: Interfacing DC Power. Added new cables to Appendix D. Major updates throughout.
12/14/2007	R121407	Minor corrections and modifications. Relevant to Frimware Version 3.0.02
03/17/2008	R031708	Added CW/CCW to the list of clock option labels for the differential input version. Functionality is the same as the up/down clock type. Added qualification os personnel and intended use statements to inside front.
07/11/2008	R030708	Updated to give visibility to isolated USB to SPI Communications Converter cables and new Mating Connector Kits.

MDrive34Plus Microstepping
Revision R071108

Important information

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or un-braked movements can never be totally excluded without additional safety equipment. For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

Qualification of personnel

Only technicians who are familiar with and understand the contents of this manual and the other relevant documentation are authorized to work on and with this drive system. The technicians must be able to detect potential dangers that may be caused by setting parameters, changing parameter values and generally by the operation of mechanical, electrical and electronic equipment.

The technicians must have sufficient technical training, knowledge and experience to recognise and avoid dangers.

The technicians must be familiar with the relevant standards, regulations and safety regulations that must be observed when working on the drive system.

Intended Use

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or unbraked movements can never be totally excluded without additional safety equipment.

For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

In all cases the applicable safety regulations and the specified operating conditions, such as environmental conditions and specified technical data, must be observed.

The drive system must not be commissioned and operated until completion of installation in accordance with the EMC regulations and the specifications in this manual. To prevent personal injury and damage to property damaged drive systems must not be installed or operated.

Changes and modifications of the drive systems are not permitted and if made all no warranty and liability will be accepted.

The drive system must be operated only with the specified wiring and approved accessories. In general, use only original accessories and spare parts.

The drive systems must not be operated in an environment subject to explosion hazard (ex area).

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MDrive34Plus Microstepping

WARNING! The MDrive has components which are sensitive to Electrostatic Discharge (ESD). All handling should be done at an ESD protected workstation.

WARNING! Hazardous voltage levels may be present if using an open frame power supply to power your MDrive product.

WARNING! Ensure that the power supply output voltage does not exceed the maximum input voltage of the MDrive34Plus (+75 VDC).

Before You Begin

The Quick Start guide is designed to help quickly connect and begin using your MDrive34Plus Microstepping integrated motor and driver. The following examples will help you get the motor turning for the first time and introduce you to the basic settings of the drive.

Tools and Equipment Required

- MDrive34Plus Microstepping Unit (MDM34).
- Parameter setup cable MD-CC300-000 (USB to SPI) or equivalent and adapter MD-ADP-1723C for pluggable interface.
- Product CD or Internet access to www.imshome.com.
- Control Device for Step/Direction.
- +5 to +24 VDC optocoupler supply.
- An Unregulated +12 to +75 VDC Power Supply.
- Basic Tools: Wire Cutters / Strippers / Screwdriver.
- 18 AWG Wire for Power Supply, 22-28 AWG Wire for Logic Connections (Not Required for Flying Leads version).
- A PC with Windows XP SP2.

Note: A characteristic of all motors is back EMF. Back EMF is a source of current that can push the output of a power supply beyond the maximum operating voltage of the driver. As a result, damage to the stepper driver could occur over a period of time. Care should be taken so that the back EMF does not exceed the maximum input voltage rating of +75 VDC.

Connecting the Power Supply

Using the 18 AWG wire, connect the DC output of the power supply to the +V input of the MDrive34Plus

Connect the power supply ground to Power Ground (P3:2 - Wire Crimp, Black Flying Lead).

See Figure GS.1.

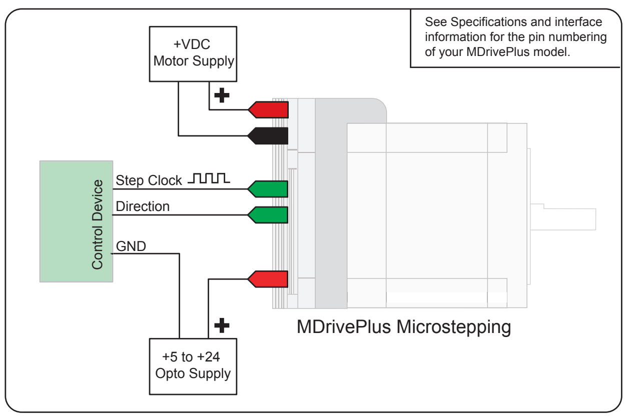


Figure GS.1: Minimum Logic and Power Connections

Connect Opto Power and Logic Inputs

Using the recommended wire, connect the following to your controller or PLC:

- Optocoupler Supply (+5 to +24 VDC)
- Step Clock Input
- Direction Input

Connecting Parameter Setup Cable

Connect the Host PC to the MDrive34Plus Microstepping using the IMS Parameter Setup Cable or equivalent. See Appendix D of this document for Cable installation instructions.

WARNING! Because the MDrive consists of two core components, a drive and a motor, close attention must be paid to the thermal environment where the device is used. Operating Range is -40 to +75°C.

Note: Interactive usage tutorials are available at the IMS Web Site at http://www.imshome.com/tutorials.html

Install the IMS SPI Motor Interface

The IMS SPI Motor Interface is a utility that easily allows you to set up the parameters of your MDrive34Plus Microstepping. It is available both on the MDrive34Plus CD that came with your product and on the IMS web site at http://www.imshome.com/software_interfaces.html.

1. Download the IMS SPI Motor Interface from http://www.imshome.com/software_interfaces.html.
2. Extract to a location on you hard drive.
3. Double-Click the setup.exe file.
4. Follow the on-screen instructions.
5. Once IMS SPI Motor Interface is installed, the MDrive34Plus Microstepping settings can be checked and/or set.

Once installed you can change the motor run current, holding current, microstep resolution and other configuration settings. By sending clock pulses to the drive you can now change these settings safely on-the-fly as the IMS SPI Motor interface will not allow you to set an out-of-range value.

The motor can be run using the default settings without connecting communications or changing the parameters.

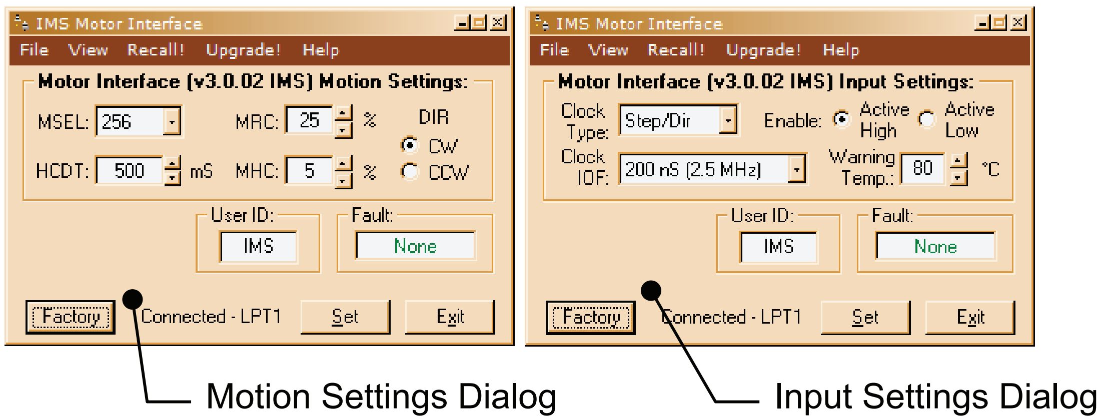
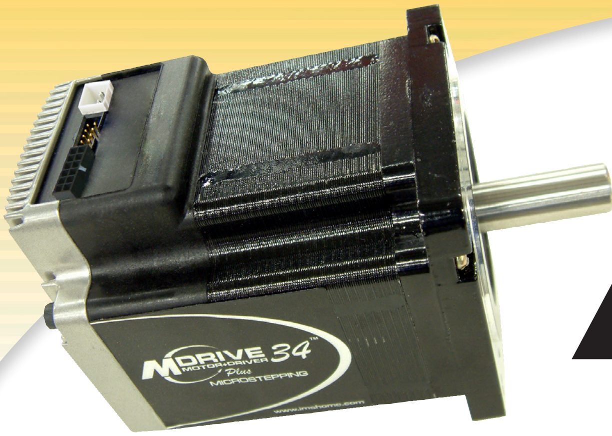


Figure GS.2: IMS Motor Interface Showing Default Settings



MDRIVE™ MOTOR+DRIVER Plus

MICROSTEPPING

PART 1: HARDWARE SPECIFICATIONS

Section 1.1: MDrive34Plus Microstepping Product Introduction

Section 1.2: MDrive34Plus Microstepping Detailed Specifications

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SECTION 1.1

Introduction to the MDrive34Plus Microstepping

The MDrive34Plus Microstepping high torque integrated motor and driver is ideal for designers who want the simplicity of a motor with on-board electronics. The integrated electronics of the MDrive34Plus eliminate the need to run motor cabling through the machine, reducing the potential for problems due to electrical noise.

The unsurpassed smoothness and performance delivered by the MDrive34Plus Microstepping are achieved through IMS's advanced 2nd generation current control. By applying innovative techniques to control current flow through the motor, resonance is significantly dampened over the entire speed range and audible noise is reduced.

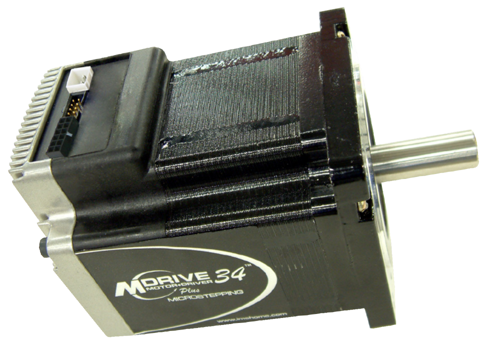


Figure 1.1.1: MDrive34Plus Microstepping Integrated Motor and Driver Electronics

The MDrive34Plus accepts a broad input voltage range from +12 to +75 VDC, delivering enhanced performance and speed. Oversized input capacitors are used to minimize power line surges, reducing problems that can occur with long runs and multiple drive systems. An extended operating range of –40° to +75°C (heat sink), –40° to +90°C (Motor) provides long life, trouble free service in demanding environments.

The MDrive34Plus uses a NEMA 34 frame size high torque brushless motor combined with a microstepping driver, and accepts up to 20 resolution settings from full to 256 microsteps per full step, including: degrees, metric and arc minutes. These settings may be changed on-the-fly or downloaded and stored in nonvolatile memory with the use of a simple GUI which is provided. This eliminates the need for external switches or resistors. Parameters are changed via an SPI port.

The versatile MDrive34Plus Microstepping is available in multiple configurations to fit various system needs. Rotary motor versions come in three lengths and may include an internal optical encoder, control knob or planetary gearbox. Interface connections are accomplished with either a pluggable locking wire crimp or 12.0" (30.5 cm) flying leads.

The MDrive34Plus is a compact, powerful and inexpensive solution that will reduce system cost, design and assembly time for a large range of brushless motor applications.

Configuration Interface

The IMS Motor Interface software is an easy to install and use GUI for configuring the MDrive34Plus from a computer's USB port. GUI access is via the IMS SPI Motor Interface included on the CD shipped with the product, or from www.imshome.com. Optional cables are available for ease of connecting and configuring the MDrive.

- Easy installation.
- Automatic detection of MDrive version and communication configuration.
- Will not set out-of-range values.
- Tool-tips display valid range setting for each option.
- Simple screen interfaces.

Features and Benefits

- Highly Integrated Microstepping Driver and NEMA 34 High Torque Brushless Motor
- Advanced 2nd Generation Current Control for Exceptional Performance and Smoothness
- Single Supply: +12 to +75 VDC
  - Low Cost
  - Extremely Compact
- 20 Microstep Resolutions up to
  - 51,200 Steps Per Rev Including:
  - Degrees, Metric, Arc Minutes
- Optically Isolated Logic Inputs will
  - Accept +5 to +24 VDC Signals
  - Sourcing or Sinking
- Automatic Current Reduction
- Configurable:

- Motor Run/Hold Current
- Motor Direction vs. Direction Input
- Microstep Resolution
- Clock Type: Step and Direction, Quadrature, Step Up and Step Down
- Programmable Digital Filtering for Clock and Direction Inputs

- Available Options:
  - Internal Optical Encoder
  - Integrated Planetary Gearbox
  - Control Knob for Manual Positioning
- 3 Rotary Motor Lengths Available
- Current and Microstep Resolution May Be Switched On-The-Fly
- Interface Options:
  - Pluggable Locking Wire Crimp
  - 12.0" (30.5 cm) Flying Leads
- Graphical User Interface (GUI) for Quick and Easy Parameter Setup

MDrive34Plus Microstepping

WARNING! Because the MDrive consists of two core components, a drive and a motor, close attention must be paid to the thermal environment where the device is used. See Thermal Specifications.

General Specifications

Electrical Specifications	
Input Voltage (+V) Range*	+12 to +75 VDC
Max Power Supply Current (Per MDrive34Plus)*	4 A

** Actual Power Supply Current will depend on Voltage and Load.*

Table 1.2.1: MDrive34Plus Microstepping Electrical Specifications

Environmental Specifications	
Heat Sink Temperature (non-condensing humidity)	-40°C to +75°C
Motor Temperature (non-condensing humidity)	-40°C to +90°C

Table 1.2.2: MDrive34Plus Microstepping Environmental Specifications

I/O Specifications	
Isolated Inputs — Step Clock, Direction and Enable	
Resolution	10 Bit
Voltage Range (Sourcing or Sinking)	+5 to +24 VDC
Current (+5 VDC Max)	8.7 mA
Current (+24 VDC Max)	14.6 mA

Table 1.2.3: MDrive34Plus Microstepping I/O Specifications

Communications Specifications	
Protocol	SPI

Table 1.2.4: MDrive34Plus Microstepping Communications Specifications

Motion Specifications	
Microstep Resolution	
Number of Resolutions	20

Available Microsteps Per Revolution									
200	400	800	1000	1600	2000	3200	5000	6400	10000
12800	20000	25000	25600	40000	50000	51200	36000[1]	21600[2]	25400[3]

1=0.01 deg/µstep 2=1 arc minute/µstep 3=0.001 mm/µstep

Digital Filter Range	50 nS to 12.9 µS (10 MHz to 38.8kHz)
Clock Types	Step/Direction, Quadrature, Clock Up/Clock Down
Step Frequency (Max)	5.0 MHz
Step Frequency Minimum Pulse Width	100 nS

Table 1.2.5: MDrive34Plus Microstepping Motion Specifications

Motor Specifications	
Single Length	
Holding Torque	381 oz-in/269 N-cm
Detent Torque	10.9 oz-in/7.7 N-cm
Rotor Inertia	0.01416 oz-in-sec^2/1.0 kg-cm^2
Weight (Motor + Driver)	4.1 lb/1.9 kg
Double Length	
Holding Torque	575 oz-in/406 N-cm
Detent Torque	14.16 oz-in/10.0 N-cm
Rotor Inertia	0.02266 oz-in-sec^2/1.6 kg-cm^2
Weight (Motor + Driver)	5.5 lb/2.5 kg
Triple Length	
Holding Torque	1061 oz-in/749 N-cm
Detent Torque	19.83 oz-in/14.0 N-cm
Rotor Inertia	0.04815 oz-in-sec^2/3.4 kg-cm^2
Weight (Motor + Driver)	8.8 lb/4.0 kg

Table 1.2.6: MDrive34Plus Microstepping Motor Specifications

Setup Parameters

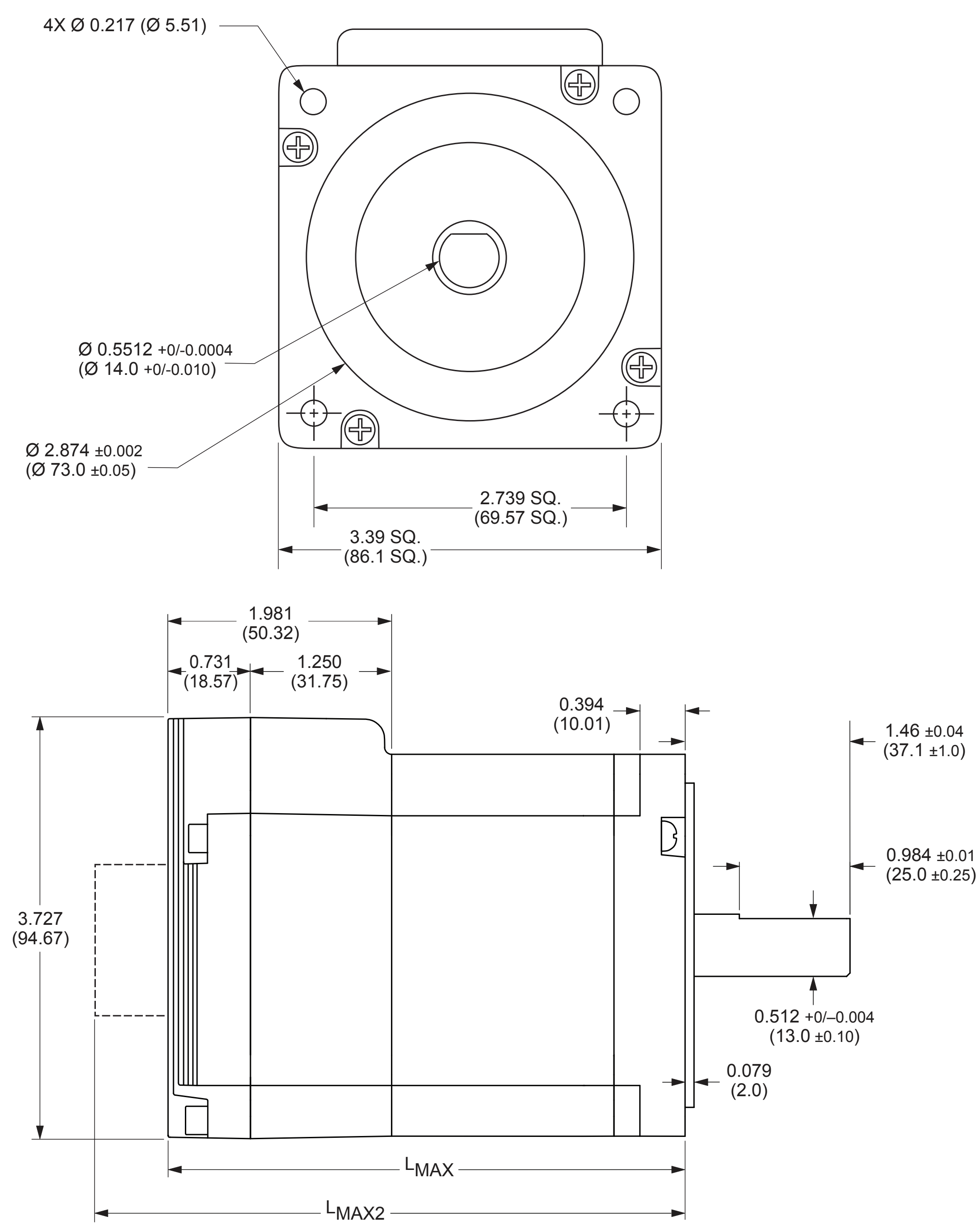
The following table illustrates the setup parameters. These are easily configured using the IMS SPI Motor Interface configuration utility. An optional Parameter Setup Cable is available and recommended with the first order.

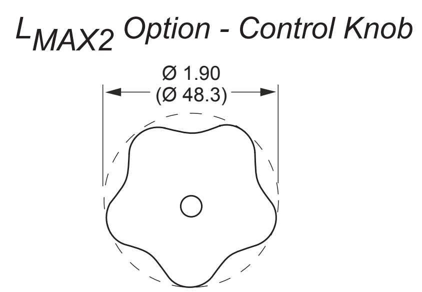
MDrive17Plus Microstepping Setup Parameters				
Name	**Function**	**Range**	**Units**	**Default**
MHC	Motor Hold Current	0 to 100	percent	5
MRC	Motor Run Current	1 to 100	percent	25
MSEL	Microstep Resolution	1, 2, 4, 5, 8, 10, 16, 25, 32, 50, 64, 100,108, 125, 127,128, 180, 200, 250, 256	µsteps per full step	256
EN ACT	Enable Active High/Low	High/Low	—	High
DIR	Motor Direction Override	0/1	—	CW
HCDT	Hold Current Delay Time	0 or 2-65535	mSec	500
CLK TYPE	Clock Type	Step/Dir. Quadrature, Up/ Down (CW/CCW)	—	Step/Dir
CLK IOF	Clock and Direction Filter	50 nS to 12.9 µS (10 MHz to 38.8kHz)	nS (MHz)	200 nS (2.5 MHz)
WARN TEMP	Warning Temperature	0 to +125	°C	80
USER ID	User ID	1-3 characters	Viewable ASCII	IMS

Table 1.2.7: Setup Parameters

Mechanical Specifications

Dimensions in Inches (mm)





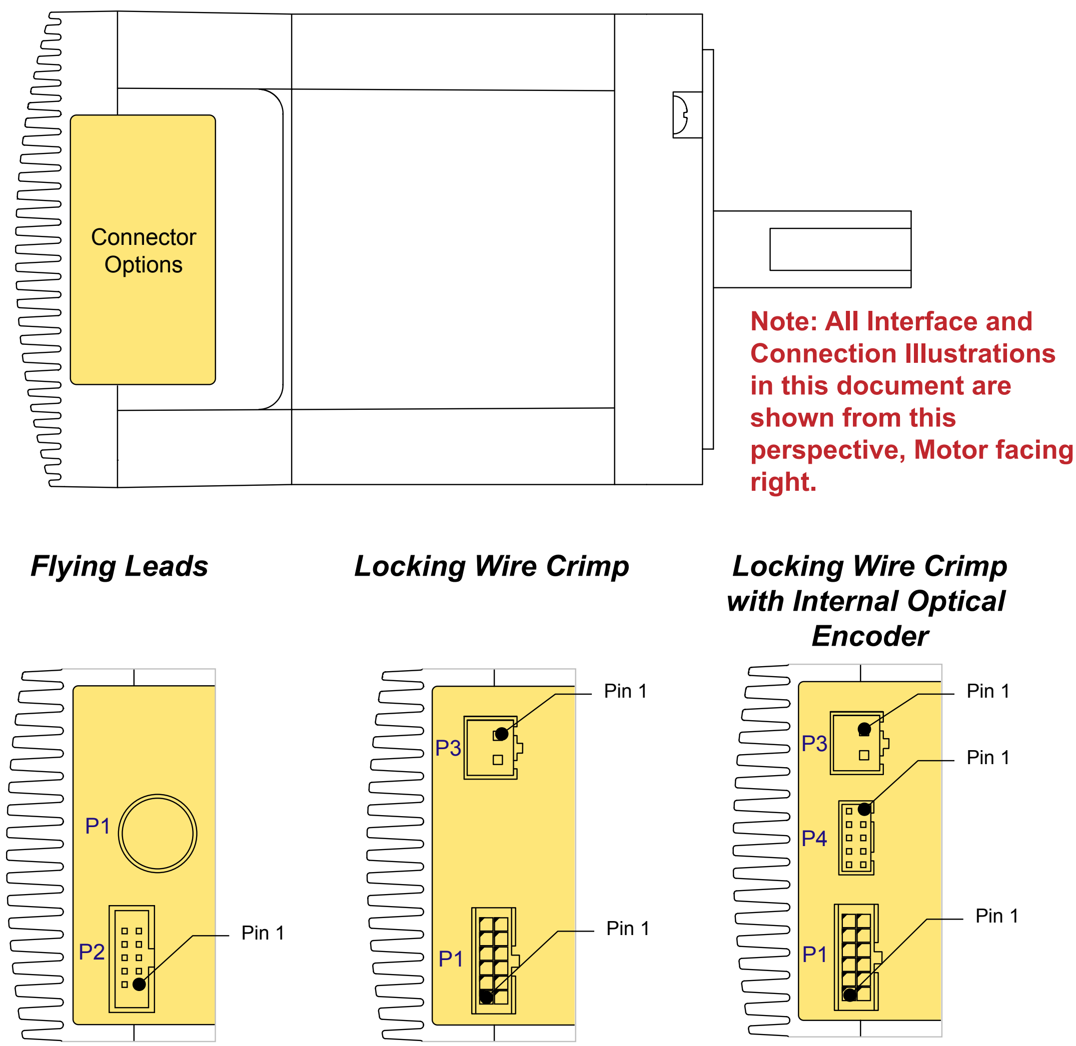
	Dimensions in inches (mm)	
Motor Length	LMAX1 (Single Shaft)	LMAX2 (Control Knob)
Single	3.81 (96.77)	4.52 (114.81)
Double	4.60 (116.84)	5.31 (134.87)
Triple	6.17 (156.72)	6.88 (174.75)

Figure 1.2.1: MDrive34Plus Microstepping Dimensional Information

Connector Options

The MDrive34Plus Microstepping comes in three Connector Options

1. 12" (30.5 cm) Flying Leads
2. Locking Wire Crimp Connectors



P1
Type: 12' (30.5 cm) Flying Leads
Function: Power, I/O and Encoder (optional)

P2
Type: 10-Pin IDC
Function: SPI Communications

P1
Type: 12-Pin Locking Wire Crimp
Function: Power, I/O and SPI Comm.

P3
Type: 2-Pin Locking Wire Crimp
Function: DC Power

P1
Type: 12-Pin Locking Wire Crimp
Function: Power, I/O and SPI Comm.

P3
Type: 2-Pin Locking Wire Crimp
Function: DC Power

P4
Type: 10-Pin Wire Crimp
Function: Differential Encoder Outputs

Figure 1.2.2: MDrive34Plus Microstepping Connector Options

Pin Assignment And Description - Flying Leads Version

P1 Connector - Power, I/O and Internal Optical Encoder (Optional)

Pin Assignment - P1 Power and I/O Connections				
Flying Lead Wire Color	**Wire Color with Internal Encoder**	**Function**		**Description**
White	White	Opto Reference		The Signal applied to the Optocoupler Reference will determine the sinking/ or sourcing configuration of the inputs. To set the inputs for sinking operation, a +5 to +24 VDC supply is connected. If sourcing, the Reference is connected to Ground
Orange	Orange	Step Clock/Channel A/ Clock Up		Step Clock input. The step clock input will receive the clock pulses which will step the motor 1 step for each pulse. It may also receive quadrature and clock up type inputs if so configured.
Blue	Blue	Direction/Channel B/ Clock Down		Direction input. The axis direction will be with respect to the state of the Direction Override Parameter. It may also receive quadrature and clock up type inputs if so configured.
Brown	Brown	Enable		Enable/Disable Input will enable or disable the driver output to the motor. In the disconnected state the driver outputs are enabled in either sinking or sourcing configuration.
Black	Black	GND		Power Ground. The return of the +12 to +75 VDC power supply.
Red	Red	+V		+12 to +75 VDC Motor Power Supply input.
		Differential	**Single-End**	
	Yellow/Black	Ground	Ground	Encoder Ground (common with power ground).
	Yellow/Violet	Index +	Index	Index + (Index Single-End) Encoder Output.
	Yellow/Blue	Channel A +	Channel A	Channel A+ (Channel A Single End) Encoder Output.
	Yellow/Red	+5 VDC Input	+5 VDC Input	+5 VDC Encoder power input.
	Yellow/Brown	Channel B +	Channel B	Channel B+ (Channel B Single End) Encoder Output.
	Yellow/Gray	Index –	—	Index – Differential Encoder Output.
	Yellow/Green	Channel A –	—	Channel A – Differential Encoder Output.
	Yellow/Orange	Channel B –	—	Channel B – Differential Encoder Output.

Table 1.2.8 P1 — Pin Assignment, Power and I/O

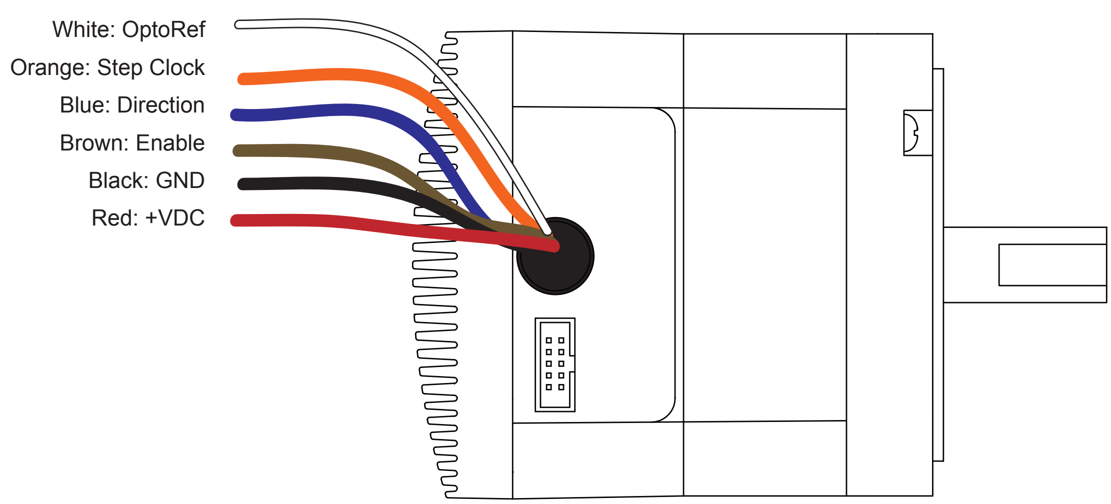


Figure 1.2.3: MDrive34Plus Microstepping Flying Leads

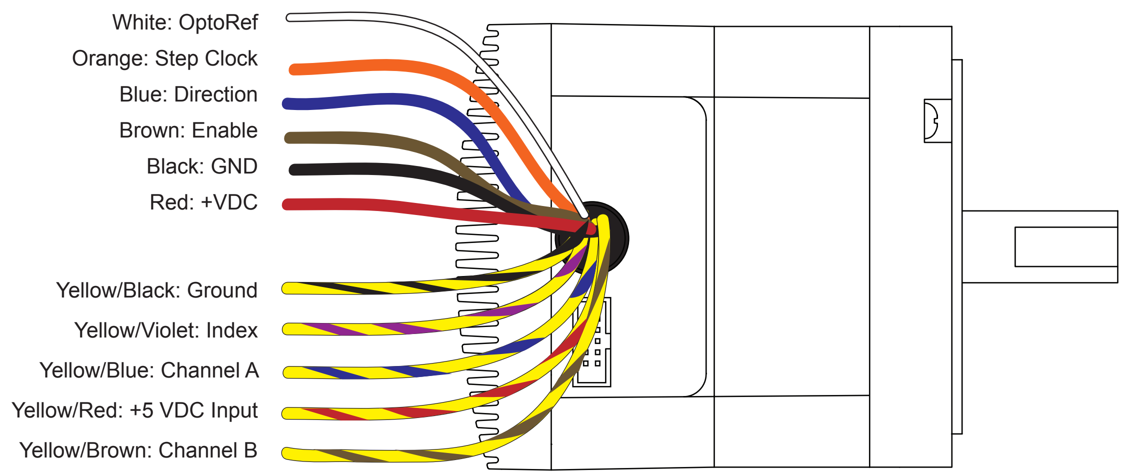


Figure 1.2.4: MDrive34Plus Microstepping Flying Leads with Single-End Encoder

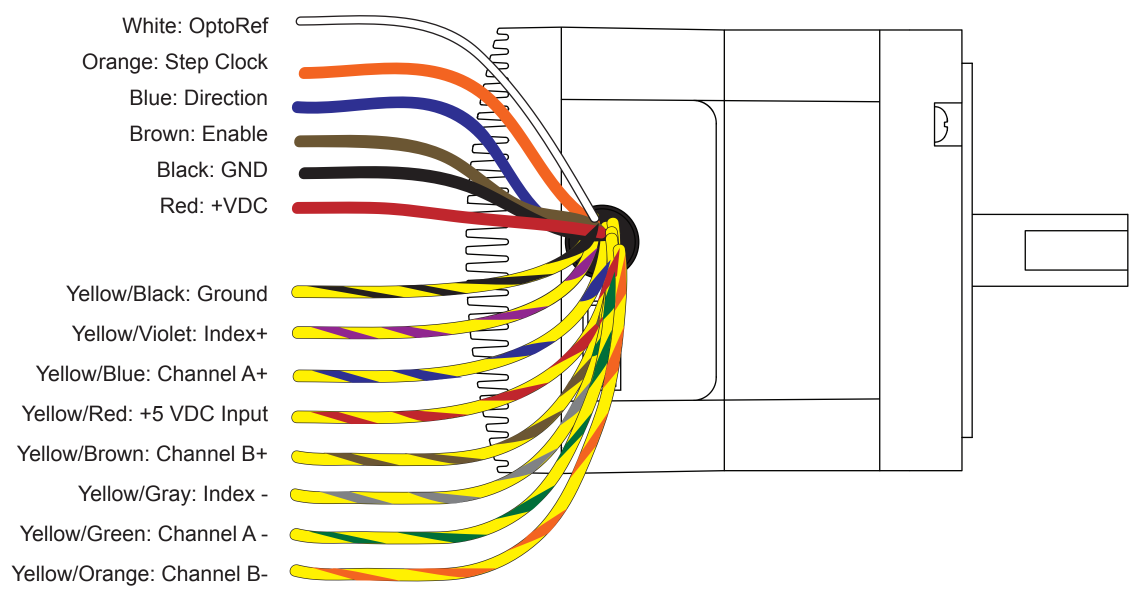


Figure 1.2.5: MDrive34Plus Microstepping Flying Leads with Differential Encoder

P2 Connector - SPI Communications

Pin Assignment - P2 SPI Communications

10-Pin IDC	Function	Description
Pin 1	—	No Connect
Pin 2	—	No Connect
Pin 3	—	No Connect
Pin 4	CS	SPI Chip Select. This signal is used to turn communications on multiple MDM units on or off.
Pin 5	GND	Communications Ground.
Pin 6	+5 VDC Output	Supply voltage for the MD-CC300-000 Cable ONLY!
Pin 7	MOSI	Master-Out/Slave-In. Carries output data from the SPI Master to the MDM.
Pin 8	SPI Clock	The Clock is driven by the SPI Master. The clock cycles once for each data bit.
Pin 9	—	No Connect
Pin 10	MISO	Master-In/Slave-Out. Carries output data from the MDM back to the SPI Master.
Recommended Converter/Cable		
MD-CC300-000		

Table 1.2.9: P2 Connector – SPI Communications

Recommended Cable:
MD-CC300-000

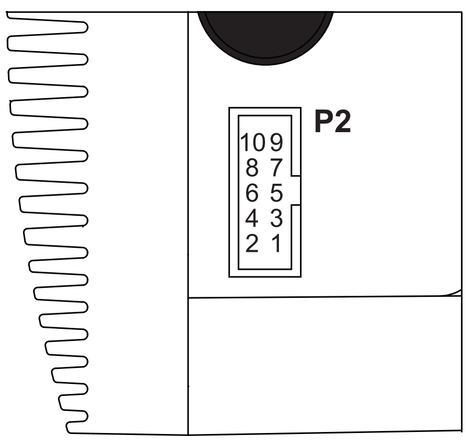
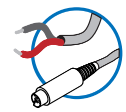


Figure 1.2.6: P2 Connector - SPI Communications

Note: The P2 Connector (10-Pin IDC, SPI Communications) is only available on the Flying Leads version of the MDrive34Plus Microstepping. On the models with pluggable connectors, SPI Communications interfaces to P1 (12-Pin Locking Wire Crimp)

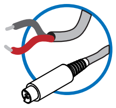


NEED A CABLE? The following cables and converters are available to interface communications with P2:

USB to SPI:
MD-C300-000

10 Pin IDC to 12-Pin Locking Wire Crimp Adapter:
MD-ADP-1723C

See Appendix C for details.



NEED A CABLE? The following cables and converters are available to interface with P1:

12-Pin Locking Wire Crimp
PD12-1434-FL3

Pin Assignment And Description - Pluggable Interface Version

P1 Connector - I/O and SPI Communications, 12-Pin Locking Wire Crimp

Pin Assignment - P1 Power, I/O and SPI Connections

Pin #	Function	Description
Pin 1	N/C	No Connect.
Pin 2	N/C	No Connect.
Pin 3	Opto Reference	The Signal applied to the Optocoupler Reference will determine the sinking/ or sourcing configuration of the inputs. To set the inputs for sinking operation, a +5 to +24 VDC supply is connected. If sourcing, the Reference is connected to Ground
Pin 4	Step Clock/Channel A/ Clock Up	Step Clock input. The step clock input will receive the clock pulses which will step the motor 1 step for each pulse. It may also receive quadrature and clock up type inputs if so configured.
Pin 5	Enable	Enable/Disable Input will enable or disable the driver output to the motor. In the disconnected state the driver outputs are enabled in either sinking or sourcing configuration. Enable can be configured as either active high or active when low in the parameters.
Pin 6	Direction/Channel B/ Clock Down	Direction input. The axis direction will be with respect to the state of the Direction Override Parameter. It may also receive quadrature and clock up type inputs if so configured.
Pin 7	+5 VDC Output	Supply voltage for the MD-CC300-000 Cable ONLY!
Pin 8	SPI Clock	The Clock is driven by the SPI Master. The clock cycles once for each data bit.
Pin 9	GND	Communications Ground.
Pin 10	MOSI	Master-Out/Slave-In. Carries output data from the SPI Master to the MDM.
Pin 11	CS	SPI Chip Select. This signal is used to turn communications on multiple MDM units on or off.
Pin 12	MISO	Master-In/Slave-Out. Carries output data from the MDM back to the SPI Master.

Table 1.2.10: P1 Connector – I/O and SPI Communications

Recommended Cable:
PD12-1434-FL3

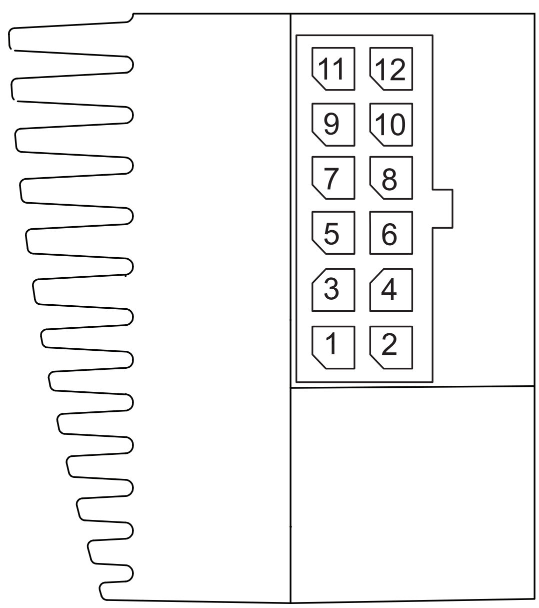


Figure 1.2.7: P2 Connector - I/O and SPI Communications

P3 Connector - DC Power, 2-Pin Locking Wire Crimp

Pin Assignment - P3 Power		
2-Pin Locking Wire Crimp	**Function**	**Description**
Pin 1	+V	+12 to +75 VDC, 4 Amps Maximum per MDrive34Plus.
Pin 2	GND	Power Supply Return.

Table 1.2.11: P3 Connector

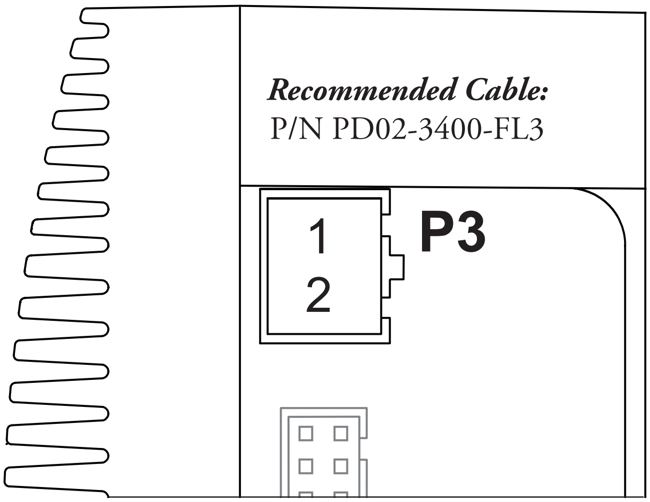
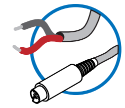


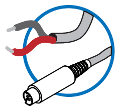
Figure 1.2.8: P3 Connector - DC Power +12 to +75 VDC



NEED A CABLE? The following cables and converters are available to interface with P3:

2-Pin Locking Wire Crimp
PD02-3400-FL3

WARNING! Do not plug or unplug DC Power with power applied.



NEED A CABLE? The following cables and converters are available to interface with P4:

10-Pin Friction Lock Wire Crimp
PD10-3400-FL3

P4 Connector - Differential Encoder, 10-Pin Friction Lock Wire Crimp

Pin Assignment - P2 SPI Communications		
10-Pin Wire Crimp	***Function***	***Description***
Pin 1	Ground	Encoder Ground, common with power ground.
Pin 2	Channel A+	Channel A + Encoder Output.
Pin 3	Channel A –	Channel A – Encoder Output.
Pin 4	Channel B+	Channel B + Encoder Output.
Pin 5	Channel B –	Channel B – Encoder Output.
Pin 6	Index +	Index + Encoder Output.
Pin 7	Index –	Index – Encoder Output.
Pin 8	+5 VDC	+5 VDC Encoder Power.
Pin 9	N/C	No connect
Pin 10	N/C	No connect
Recommended Cable		
PD10-3400-FL3		

Table 1.2.12: P4 Connector – Optional Internal Differential Encoder

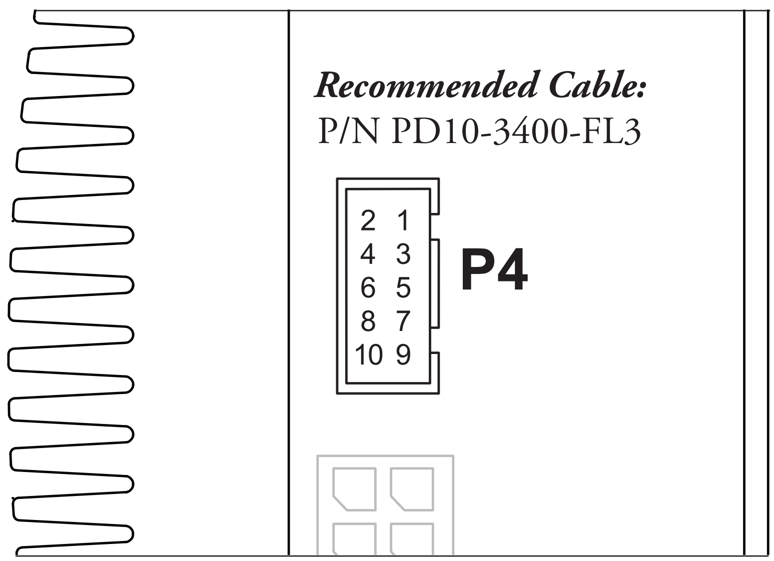


Figure 1.2.9: P4 Connector – Internal Differential Encoder Interface

Connectivity

QuickStart Kit

For rapid design verification, all-inclusive QuickStart Kits have communication converter, prototype development cable(s), instructions and CD for MDrivePlus initial functional setup and system testing.

Communication Converters

Electrically isolated, in-line converters pre-wired with mating connectors to conveniently set/program communication parameters for a single MDrivePlus via a PC's USB port. Length 12.0' (3.6m).

Mates to connector:

10-Pin IDC MD-CC300-001
12-Pin Wire Crimp..MD-CC303-001

Prototype Development Cables

Speed test/development with pre-wired mating connectors that have flying leads other end. Length 10.0' (3.0m).

Mates to connector:

12-Pin Wire Crimp.. PD12-1434-FL3
10-Pin Wire Crimp.. PD10-3400-FL3
2-Pin Wire Crimp.. PD02-3400-FL3

Mating Connector Kits

Use to build your own cables. Kits contain 5 mating shells with pins. Cable not supplied. Manufacturer's crimp tool recommended.

Mates to connector:

12-Pin Wire Crimp...CK-03
10-Pin Wire Crimp...CK-02
2-Pin Wire Crimp...CK-05

Kit contains 5 mating connectors that press fit onto ribbon cable. Cable not supplied.

10-Pin IDC CK-01

Options

Internal Encoder

Internal optical encoders are offered factory-mounted with the MDrive34Plus Microstepping. Refer to the Encoder Specifications section for available styles, line counts and part numbers. All encoders come with an index mark.

Control Knob

The MDrive34Plus is available with a factory-mounted rear control knob for manual shaft positioning.

Planetary Gearbox

Efficient, low maintenance planetary gearboxes are
offered assembled with the MDrive34Plus. Refer to details and part numbers on the back cover.

Linear Slide

Integrated linear slides are available factory installed for precision linear movement. Screw leads are 0.1", 0.2", 0.5" or 1.0" of travel per rev. Slides are 12.0" (30.5cm) to 42.0" (106.7cm) long. Contact factory for custom lengths. Refer to separate datasheet or web site for complete details.

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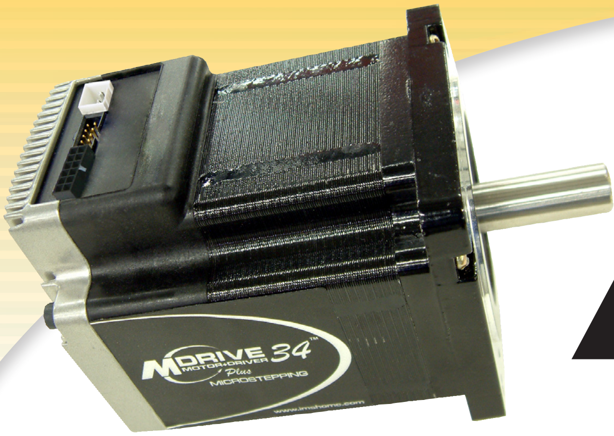

MDRIVE™ MOTOR+DRIVER Plus MICROSTEPPING

PART 2: INTERFACING AND CONFIGURING

Section 2.1: Mounting and Interface Guidelines

Section 2.2: Interfacing DC Power

Section 2.3: Interfacing Logic Inputs

Section 2.4: Interfacing SPI Communications

Section 2.3: Using the IMS SPI Motor Interface

Section 2.4: Using User-Defined SPI

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Mounting and Interface Guidelines

Mounting Recommendations

Flange mounting holes are drilled through with a diameter of 0.217" (5.51mm) to take standard 10-32 (M5) screws. The length of the screw used will be determined by the mounting flange width.

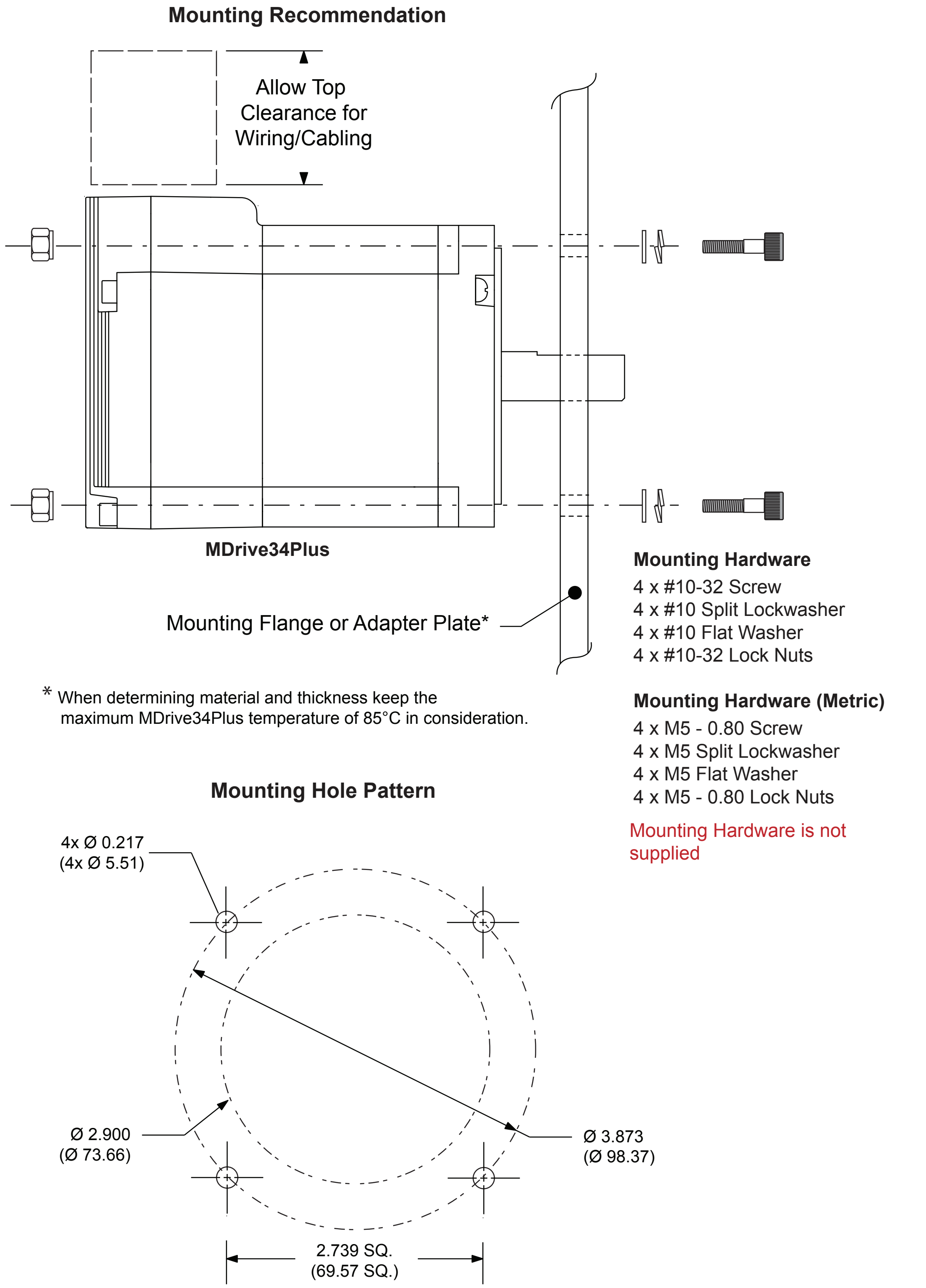

Figure 2.1.1: Mounting Recommendations and Drill Pattern

Layout and Interface Guidelines

Logic level cables must not run parallel to power cables. Power cables will introduce noise into the logic level cables and make your system unreliable.

Logic level cables must be shielded to reduce the chance of EMI induced noise. The shield needs to be grounded at the signal source to earth. The other end of the shield must not be tied to anything, but allowed to float. This allows the shield to act as a drain.

Power supply leads to the MDrivePlus need to be twisted. If more than one driver is to be connected to the same power supply, run separate power and ground leads from the supply to each driver.

Rules of Wiring

- Power Supply and Motor wiring should be shielded twisted pairs, and run separately from signal-carrying wires.
- A minimum of one twist per inch is recommended.
- Motor wiring should be shielded twisted pairs using 20 gauge, or for distances of more than 5 feet, 18 gauge or better.
- Power ground return should be as short as possible to established ground.
- Power supply wiring should be shielded twisted pairs of 18 gauge for less than 4 amps DC and 16 gauge for more than 4 amps DC.

Rules of Shielding

- The shield must be tied to zero-signal reference potential. It is necessary that the signal be earthed or grounded, for the shield to become earthed or grounded. Earthing or grounding the shield is not effective if the signal is not earthed or grounded.
- Do not assume that Earth ground is a true Earth ground. Depending on the distance from the main power cabinet, it may be necessary to sink a ground rod at the critical location.
- The shield must be connected so that shield currents drain to signal-earth connections.
- The number of separate shields required in a system is equal to the number of independent signals being processed plus one for each power entrance.
- The shield should be tied to a single point to prevent ground loops.
- A second shield can be used over the primary shield; however, the second shield is tied to ground at both ends.

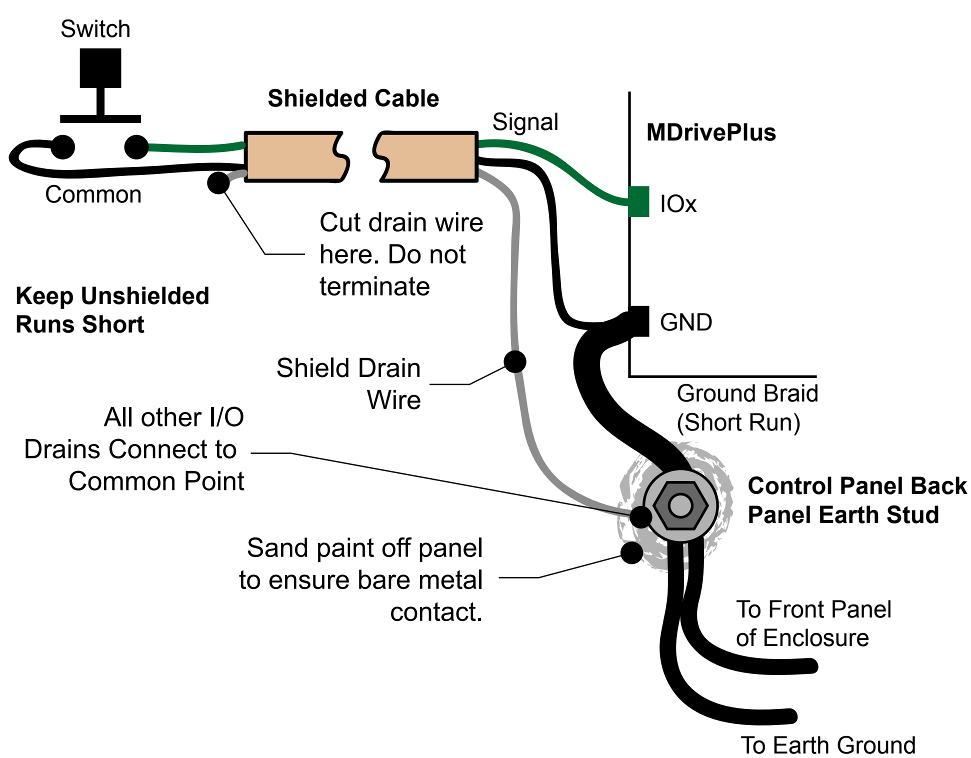

Figure 2.1.2: Grounding and Shielding for Logic Connections

Recommended Wiring

The following wiring/cabling is recommended for use with the MDrivePlus:

Logic Wiring...22 AWG
Wire Strip Length ....0.25" (6.0 mm)
Power and Ground ....See Section 2.2: Interfacing Power

Recommended Mating Connectors and Pins

The recommended connector shells and pins are available from IMS as a kit consisting of five (5) connector shells and crimp pins (if required) to construct 5 cable-ends. Also available are communications converters and Prototype Development cables to aid in rapid design and prototyping. These connector kits and cables are detailed in Appendix E of this document.

SPI Communications (Flying Lead Version Only)

Press-Fit IDC - P2 (MDrive34Plus Only)

Mating Connector Kit.. CK-01
Communications Converter... MD-CC300-001

Manufacturer PNs
10-Pin IDC .... Samtec: TCSD-05-01-N
Ribbon Cable .... Tyco: 1-57051-9

12-Pin Locking Wire Crimp (I/O and SPI Communications)

I/O & Communications - P1

Mating Connector Kit.. CK-03
Communications Converter... MD-CC303-001
Prototype Development Cable PD12-1434-FL3

Manufacturer PNs
12-pin Locking Wire Crimp Connector Shell .... Tyco 1-794617-2
Crimp Pins... Tyco 794610-0-1
Crimp Tool .... Tyco 91501-1

2-Pin Locking Wire Crimp (Power)

The following mating connectors are recommended for the MDrive34Plus^2 Units ONLY! Please contact a JST distributor for ordering and pricing information.

Power - P3

Mating Connector Kit.. CK-05
Prototype Development Cable PD02-3400-FL3

Manufacturer PNs
2-pin Locking Wire Crimp Connector Shell .... Molex 51067-0200
Crimp Pins... Molex 50217-9101 Brass
Crimp Tool .... Molex 63811-1200

WARNING! DO NOT bundle the logic leads with the power leads as this could lead to noise induced errors.

10-Pin Friction Lock Wire Crimp (Internal Differential Encoder)

Friction Lock Wire Crimp - P4

10-pin Friction Lock)... Hirose DF11-10DS-2C
Crimp Contact for 10-pin Friction Lock (22 AWG)................... DF11-22SC
Crimp Contact for 10-pin Friction Lock (24 - 28 AWG) DF11-2428SC
Crimp Contact for 10-pin Friction Lock (30 AWG).................... DF11-30SC

Securing Power Leads and Logic Leads

Some applications may require that the MDrive move with the axis motion. If this is a requirement of your application, the motor leads must be properly anchored. This will prevent flexing and tugging which can cause damage at critical connection points within the MDrive.

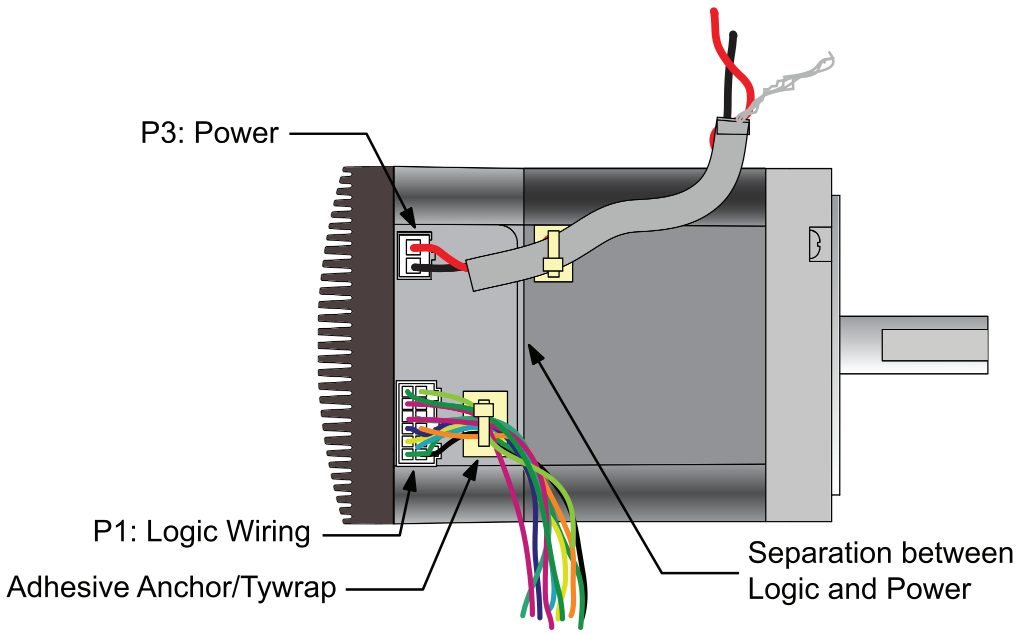

Figure 2.1.3: Typical MDrive Shown with Leads Secured

SECTION 2.2

Interfacing DC Power

Choosing a Power Supply for Your MDrive

When choosing a power supply for your MDrivePlus there are performance and sizing issues that must be addressed. An undersized power supply can lead to poor performance and even possible damage to the device, which can be both time consuming and expensive. However, The design of the MDrivePlus is quite efficient and may not require as large a supply as you might suspect.

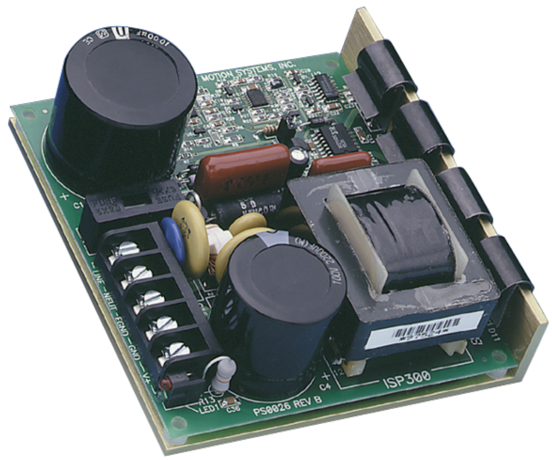

Figure 2.2.1: IMS ISP300 Switch Mode Power Supply

Motors have windings that are electrically just inductors, and with inductors comes resistance and inductance. Winding resistance and inductance result in a L/R time constant that resists the change in current. It requires five time constants to reach nominal current. To effectively manipulate the di/dt or the rate of charge, the voltage applied is increased. When traveling at high speeds there is less time between steps to reach current. The point where the rate of commutation does not allow the driver to reach full current is referred to as Voltage Mode. Ideally you want to be in Current Mode, which is when the drive is achieving the desired current between steps. Simply stated, a higher voltage will decrease the time it takes to charge the coil, and therefore will allow for higher torque at higher speeds.

Another characteristic of all motors is Back EMF, and though nothing can be done about back EMF, we can give a path of low impedance by supplying enough output capacitance. Back EMF is a source of current that can push the output of a power supply beyond the maximum operating voltage of the driver and as a result could damage the MDrivePlus over time.

The MDrivePlus is very current efficient as far as the power supply is concerned. Once the motor has charged one or both windings of the motor, all the power supply has to do is replace losses in the system. The charged winding acts as an energy storage in that the current will re-circulate within the bridge, and in and out of each phase reservoir. While one phase is in the decaying stage of the variable chopping oscillator, the other phase is in the charging stage, this results in a less than expected current draw on the supply.

The MDrivePlus is designed with the intention that a user's power supply output will ramp up to greater or equal to the minimum operating voltage. The initial current surge is quite substantial and could damage the driver if the supply is undersized. If a power supply is undersized, upon a current surge the supply could fall below the operating range of the driver. This could cause the power supply to start oscillating in and out of the voltage range of the driver and result in damaging either the supply, driver or both. There are two types of supplies commonly used, regulated and unregulated, both of which can be switching or linear. All have their advantages and disadvantages.

An unregulated linear supply is less expensive and more resilient to current surges, however, voltage decreases with increasing current draw. This can cause serious problems if the voltage drops below the working range of the drive. Also of concern is the fluctuations in line voltage. This can cause the unregulated linear supply to be above or below the anticipated voltage.

A regulated supply maintains a stable output voltage, which is good for high speed performance. They are also not bothered by line fluctuations, however, they are more expensive. Depending on the current regulation, a regulated supply may crowbar or current clamp and lead to an oscillation that as previously stated can lead to damage. Back EMF can cause problems for regulated supplies as well. The current regeneration may be too large for the regulated supply to absorb and may lead to an over voltage condition.

Switching supplies are typically regulated and require little real-estate, which makes them attractive. However, their output response time is slow, making them ineffective for inductive loads. IMS has designed a series of low cost miniature non-regulated switchers that can handle the extreme varying load conditions which makes them ideal for the MDrivePlus.

WARNING! DO NOT Plug or unplug Power with power applied!

DC Power Supply Recommendations

The power requirements for the Motion Control MDrive34Plus are:

Output Voltage ....+12 to +75 VDC (Includes Back EMF)
Current (max. per unit) 4A
(Actual power supply current requirement will depend upon voltage and load)

Recommended IMS Power Supplies

IMS unregulated linear and unregulated switching power supplies are the best fit for IMS drive products.

IP804 Unregulated Linear Supply

Input Range

120 VAC Versions ....102-132 VAC
240 VAC Versions ....204-264 VAC

Output (All Measurements were taken at 25°C, 120 VAC, 60 Hz)

No Load Output Voltage....................76 VDC @ 0 Amps
Half Load Output....................65 VDC @ 2 Amps
Full Load output....................58 VDC @ 4 Amps

IP806 Unregulated Linear Supply

Input Range

120 VAC Versions ....102-132 VAC
240 VAC Versions ....204-264 VAC

Output (All Measurements were taken at 25°C, 120 VAC, 60 Hz)

No Load Output Voltage....................76 VDC @ 0 Amps
Half Load Output....................68 VDC @ 3 Amps
Full Load Output....................64 VDC @ 6 Amps

ISP300-7 Unregulated Switching Supply

Input Range

120 VAC Versions ....102-132 VAC
240 VAC Versions ....204-264 VAC

Output (All Measurements were taken at 25°C, 120 VAC, 60 Hz)

No Load Output Voltage....................68 VDC @ 0 Amps
Continuous Output Rating....................63 VDC @ 2 Amps
Peak Output Rating....................59 VDC @ 4 Amps

Connecting DC Power

Connect the DC Power Supply to your MDrivePlus in accordance with the following illustrations.

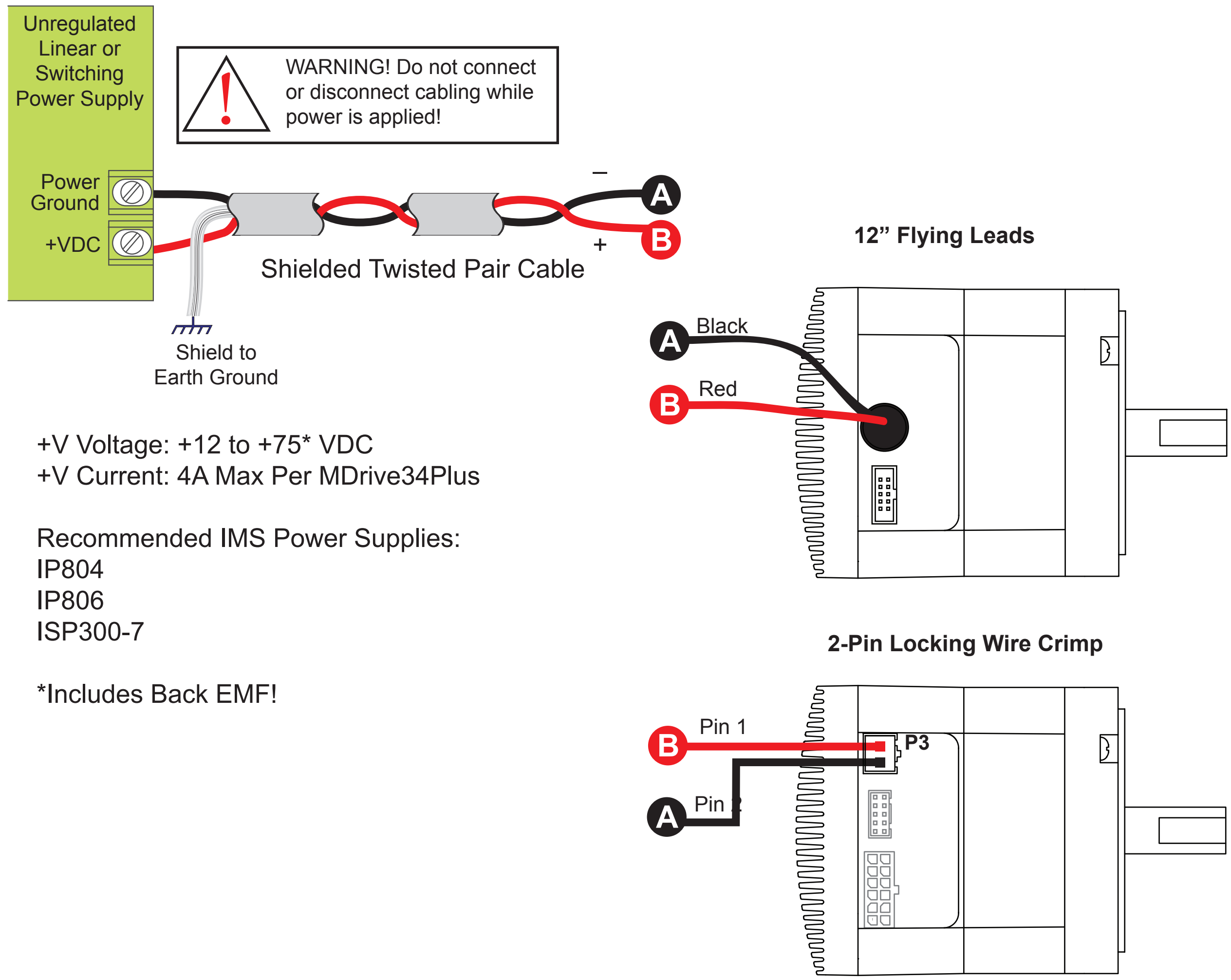

Figure 2.2.2 DC Power Connections

Recommended Power and Cable Configurations

Cable length, wire gauge and power conditioning devices play a major role in the performance of your MDrive.

Example A demonstrates the recommended cable configuration for DC power supply cabling under 50 feet long. If cabling of 50 feet or longer is required, the additional length may be gained by adding an AC power supply cable (see Examples B & C).

Correct AWG wire size is determined by the current requirement plus cable length. Please see the MDrive Supply Cable AWG Table at the end of this Appendix.

Example A – Cabling Under 50 Feet, DC Power

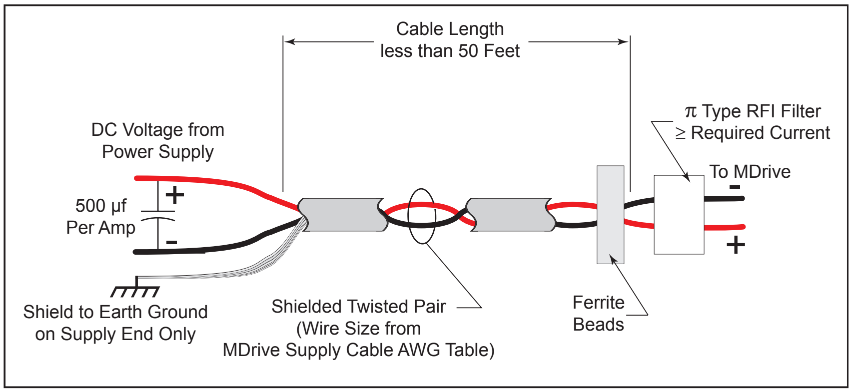

Figure 2.2.3: DC Cabling - Under 50 Feet

Example B – Cabling 50 Feet or Greater, AC Power to Full Wave Bridge

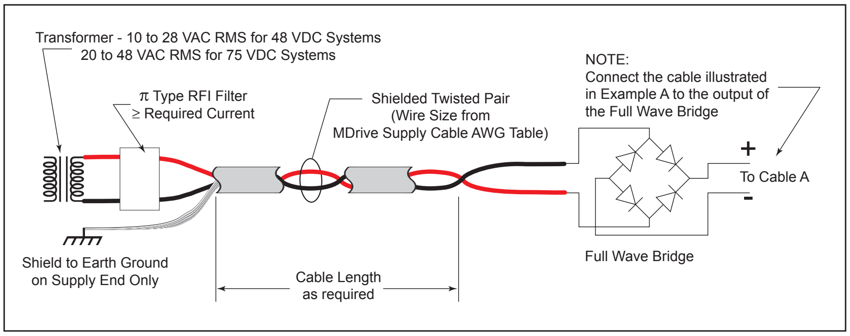

Figure 2.2.4: DC Cabling - 50 Feet or Greater - AC To Full Wave Bridge Rectifier

Example C – Cabling 50 Feet or Greater, AC Power to Power Supply

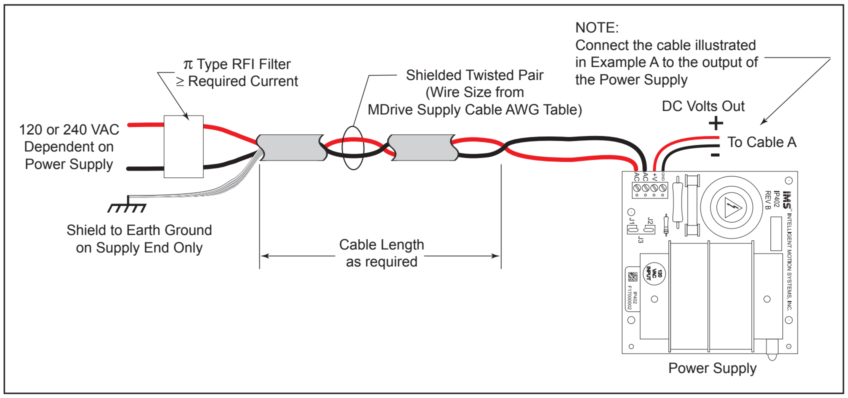

Figure 2.2.5: AC Cabling - 50 Feet or Greater - AC To Power Supply

MDrive34Plus Recommended Power Supply Cable AWG											
1 Amperes (Peak)							3 Amperes (Peak)				
Length (Feet)	10	25	50*	75*	100*		Length (Feet)	10	25	50*	75*	100*
Minimum AWG	20	20	18	18	16		Minimum AWG	18	16	14	12	12
2 Amperes (Peak)							4 Amperes (Peak)				
Length (Feet)	10	25	50*	75*	100*		Length (Feet)	10	25	50*	75*	100*
Minimum AWG	20	18	16	14	14		Minimum AWG	18	16	14	12	12

*Use the alternative methods illustrated in examples B and C when cable length is ≥ 50 feet. Also, use the same current rating when the alternate AC power is used.

Table 2.2.1: Recommended Wire Gauges

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Isolated Input Interface and Connection

Optically Isolated Logic Inputs

The MDrivePlus Microstepping has three optically isolated inputs which are located at the flying leads or on connector P1. These inputs are isolated to minimize or eliminate electrical noise coupled onto the drive control signals. Each input is internally pulled-up to the level of the optocoupler supply and may be connected to sinking or +5 to +24 VDC sourcing outputs on a controller or PLC. These inputs are:

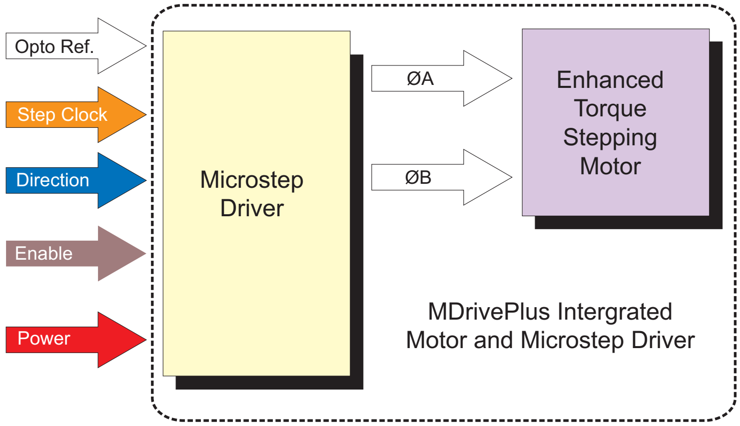


Figure 2.3.1: MDrivePlus Microstepping Block Diagram

1] Step Clock (SCLK)/Quadrature (CH A)/Clock UP

2] Direction (DIR)/Quadrature (CH B)/ Clock DOWN

3] Enable (EN)

Of these inputs only step clock and direction are required to operate the MDrivePlus Microstepping.

Isolated Logic Input Pins and Connections

The following diagram illustrates the pins and connections for the MDrive 17 and 23 Plus Microstepping family of products. Careful attention should be paid to verify the connections on the model MDrivePlus Microstepping you are using.

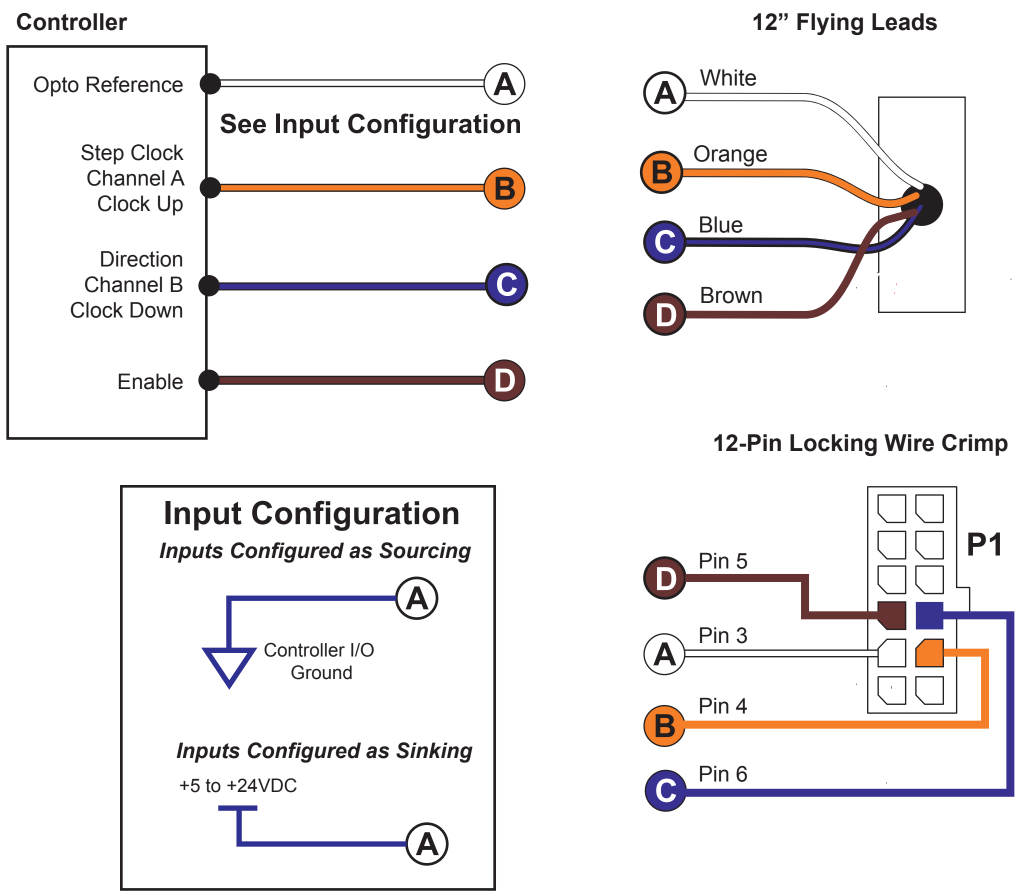


Figure 2.3.2: Isolated Input Pins and Connections

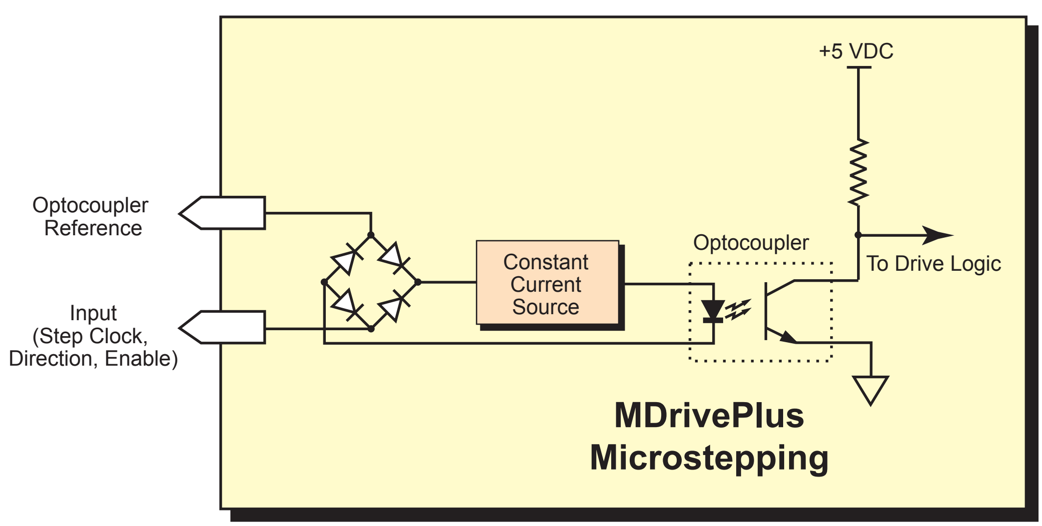


Figure 2.3.3: Optocoupler Input Circuit Diagram

Isolated Logic Input Characteristics

Enable Input

This input can be used to enable or disable the driver output circuitry. Leaving the enable switch open (Logic HIGH, Disconnected) for sinking or sourcing configuration, the driver outputs will be enabled and the step clock pulses will cause the motor to advance. When this input switch is closed (Logic LOW) in both sinking and sourcing configurations, the driver output circuitry will be disabled. Please note that the internal sine/cosine position generator will continue to increment or decrement as long as step clock pluses are being received by the MDrivePlus Microstepping.

Clock Inputs

The MDrivePlus Microstepping features the ability to configure the clock inputs based upon how the user will desire to control the drive. By default the unit is configured for the Step/Direction function.

Step Clock

The step clock input is where the motion clock from your control circuitry will be connected. The motor will advance one microstep in the plus or minus direction (based upon the state of the direction input) on the rising edge of each clock pulse. The size of this increment or decrement will depend on the microstep resolution setting.

Direction

The direction input controls the CW/CCW direction of the motor. The input may be configured as sinking or sourcing based upon the state of the Optocoupler Reference. The CW/CCW rotation, based upon the state of the input may be set using the IMS Motor Interface software included with the MDrivePlus Microstepping.

Quadrature

The Quadrature clock function would typically be used for following applications where the MDrivePlus Microstepping would be slaved to an MDrivePlus Motion Control (or other controller) in an electronic gearing application.

Up/Down

The Up/Down clock would typically be used in a dual-clock direction control application. This setting is also labeled CW/CCW in the IMS SPI Motor Interface software.

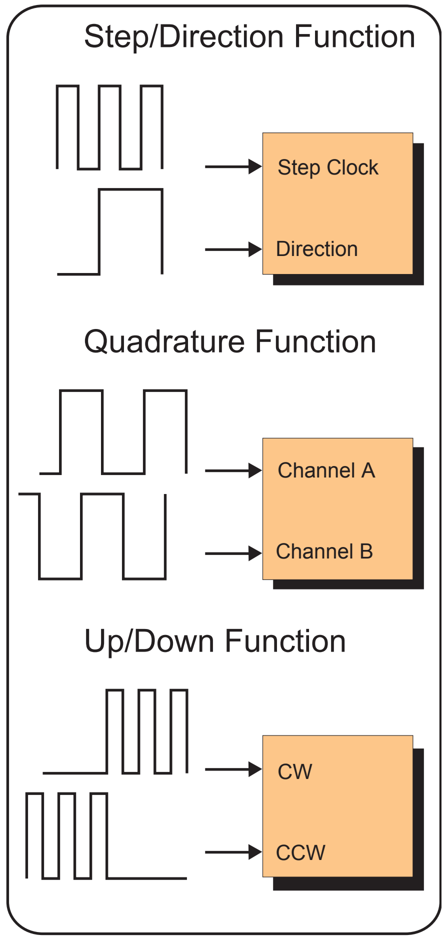


Figure 2.3.4: Input Clock Functions

Input Timing

The direction input and the microstep resolution inputs are internally synchronized to the positive going edge of the step clock input. When a step clock pulse goes HIGH, the state of the direction input and microstep resolution settings are latched. Any changes made to the direction and/or microstep resolution will occur on the rising edge of the step clock pulse following this change. Run and Hold Current changes are updated immediately. The following figure and table list the timing specifications.

Input Filtering

The clock inputs may also be filtered using the Clock IOF pull down of the IMS SPI Motor Interface. The filter range is from 50 nS (10 MHz) to 12.9 µSec. (38.8 kHz).

The configuration parameters for the input filtering is covered in detail in Section 2.4: Configuring the MDrivePlus Microstepping.

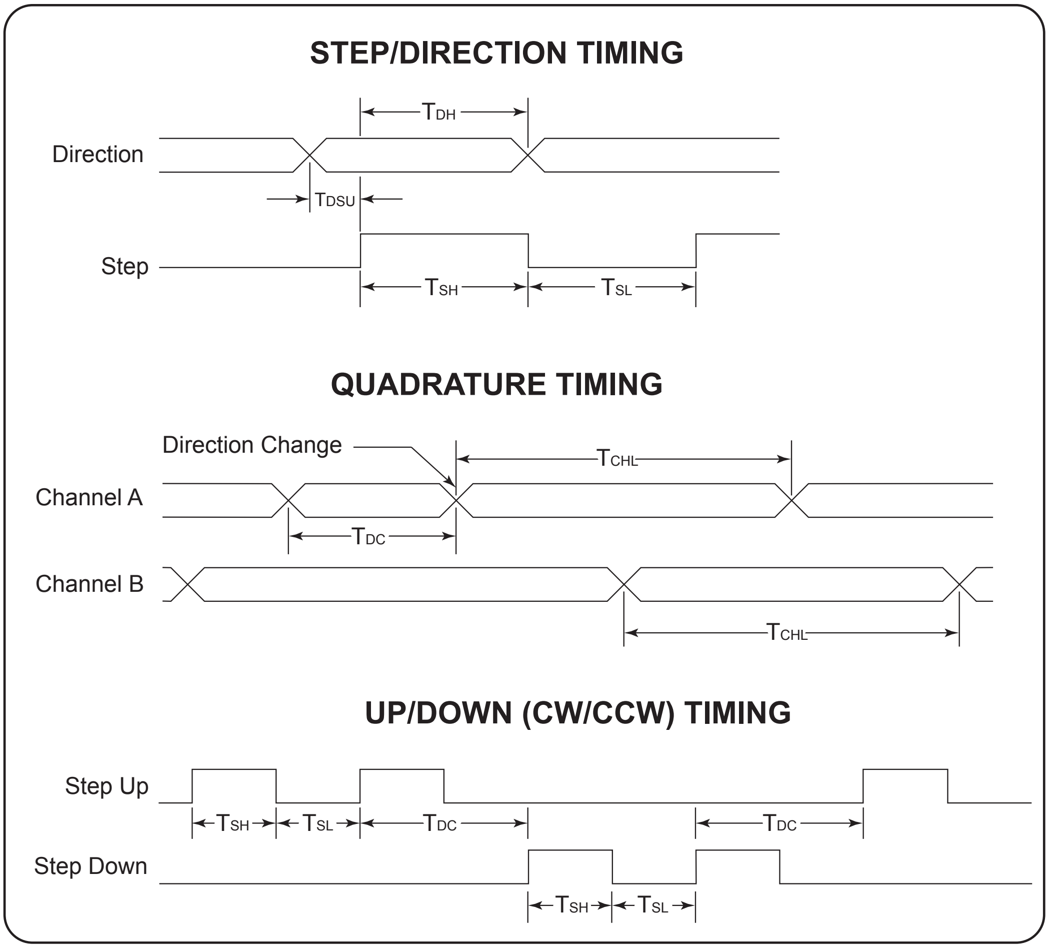


Figure 2.3.5: Clock Input Timing Characteristics

Clock Input Timing					
Symbol	Parameter	Type and Value			
		Step/Direction	Step Up/Down	Quadrature	Units
T_{DSU}	T Direction Set Up	50	—	—	nS min.
T_{DH}	T Direction Hold	100	—	—	nS min.
T_{SH}	T Step High	100	100	—	nS min.
T_{SL}	T Step Low	100	100	—	nS min.
T_{DL}	T Direction Change	—	200	200	nS min.
T_{CHL}	T Channel High/Low	—	—	400	nS min.
F_{SMAX}	F Step Maximum	5	5	—	MHz Max
F_{CHMAX}	F Channel Maximum	—	—	1.25	MHz Max
F_{ER}	F Edge Rate	—	—	5	MHz Max

Table 2.3.1: Input Clocks Timing Table

Optocoupler Reference

The MDrivePlus Microstepping Logic Inputs are optically isolated to prevent electrical noise being coupled into the inputs and causing erratic operation.

There are two ways that the Optocoupler Reference will be connected depending whether the Inputs are to be configured as sinking or sourcing.

Optocoupler Reference	
Input Type	**Optocoupler Reference Connection**
Sinking	+5 to +24 VDC
Sourcing	Controller Ground

Table 2.3.2: Optocoupler Reference Connection

NOTE: When connecting the Optocoupler Supply, it is recommended that you do not use MDrive DC Power Ground as Ground as this will defeat the optical isolation.

Ground the Opto supply at the controller I/O ground.

Input Connection Examples

The following diagrams illustrate possible connection/application of the MDrivePlus Microstepping Logic Inputs.

Open Collector Interface Example

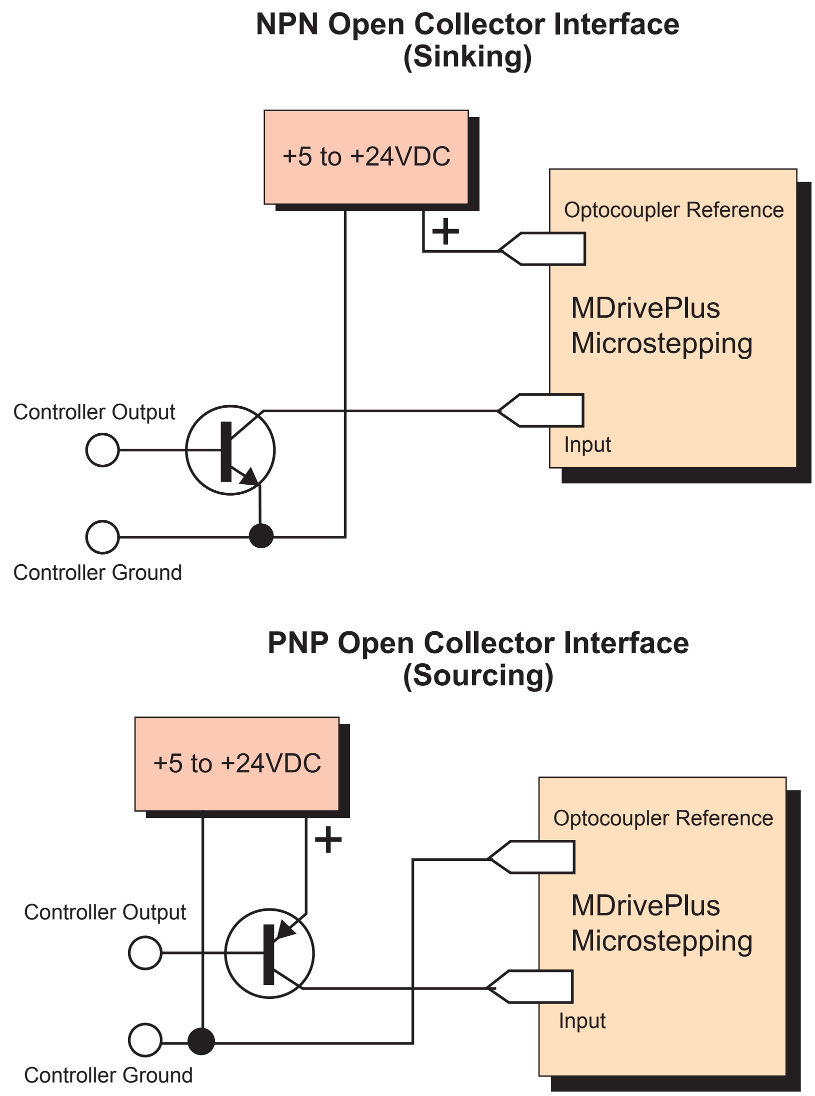


Figure 2.3.6: Open Collector Interface Example

Switch Interface Example

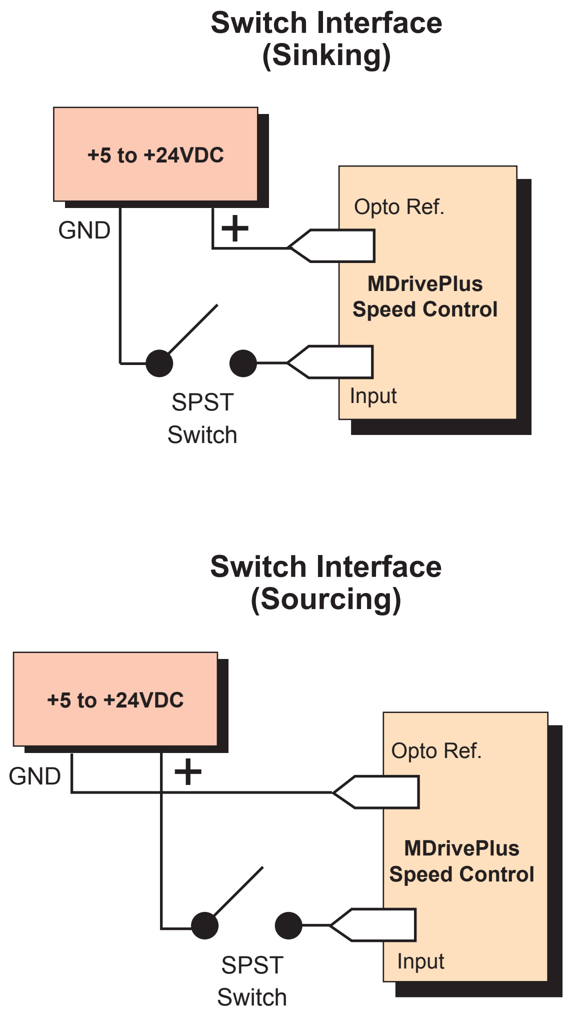


Figure 2.3.7: Switch Interface Example

Minimum Required Connections

The connections shown are the minimum required to operate the MDrivePlus Microstepping. These are illustrated in both Sinking and Sourcing Configurations. Please reference the Pin Configuration diagram and Specification Tables for the MDrivePlus Microstepping connector option you are using.

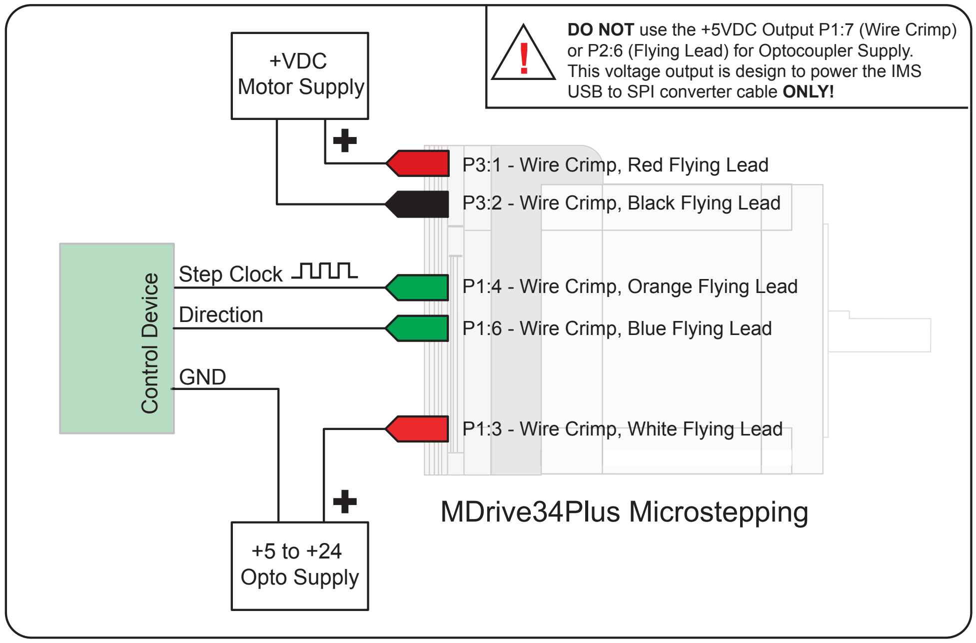


Figure 2.3.8 Minimum Required Connections

Connecting SPI Communications

Connecting the SPI Interface

The SPI (Serial Peripheral Interface) is the communications and configuration interface.

For prototyping we recommend the purchase of the parameter setup cable MD-CC300-000. For more information on prototype development cables, please see Appendix: C: Cables and Cordsets

SPI Signal Overview

+5 VDC (Output)

This output is a voltage supply for the setup cable only. It is not designed to power any external devices.

SPI Clock

The Clock is driven by the Master and regulates the flow of the data bits. The Master may transmit data at a variety of baud rates. The Clock cycles once for each bit that is transferred.

Logic Ground

This is the ground for all Communications.

MISO (Master In/Slave Out)

Carries output data from the MDrivePlus Microstepping units back to the SPI Master. Only one MDrivePlus can transmit data during any particular transfer.

CS (SPI Chip Select)

This signal is used to turn communications to multiple MDrivePlus Microstepping units on or off.

MOSI (Master Out/Slave In)

Carries output data from the SPI Master to the MDrivePlus Microstepping.

WARNING! The Parallel/SPI Port on your PC must be set to one of the following: output only

1. bi-directional
2. EPP (Extended Parallel Port)

Try the SPI connection using the default parallel port setting first. If necessary, the Parallel/SPI port may be configured in the bios of your PC.

SPI Pins and Connections

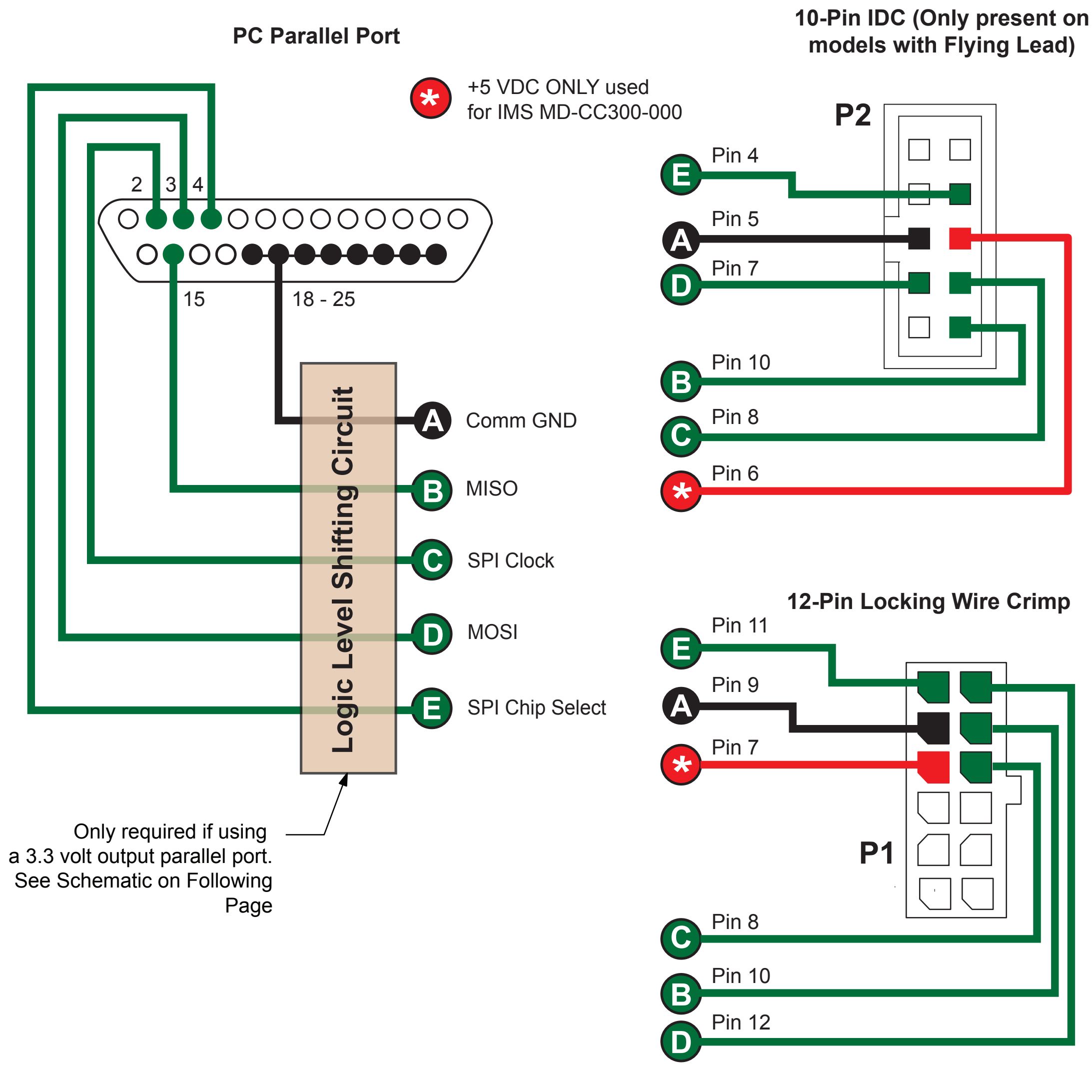


Figure 2.4.1: SPI Pins and Connection — All Connector Styles

Logic Level Shifting and Conditioning Circuit

The following circuit diagram is of a Logic Level shifting and conditioning circuit. This circuit should be used if you are making your own parameter cable and are using a laptop computer with 3.3 V output parallel ports.

N NOTE: If making your own parameter setup cable, be advised the 3.3V output parallel ports on some laptop PC's may not be sufficient to communicate with the device without use of a logic level shifting and conditioning Interface.

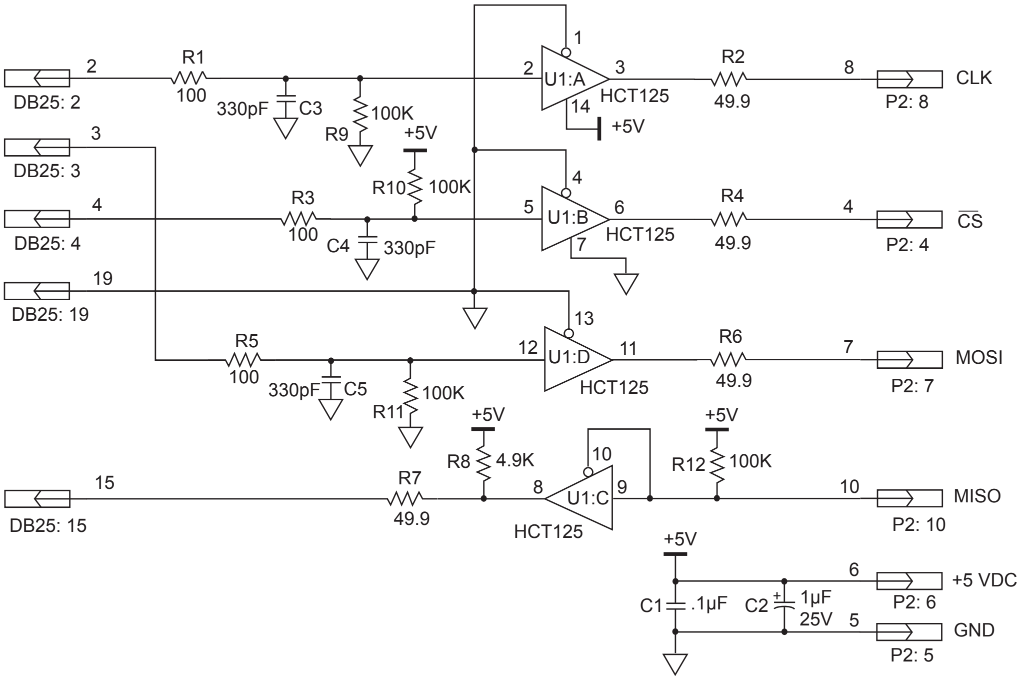


Figure 2.4.2: Logic Level Shifting and Conditioning Circuit

SPI Master with Multiple MDrivePlus Microstepping

It is possible to link multiple MDrivePlus Microstepping units in an array from a single SPI Master by wiring the system and programming the user interface to write to multiple chip selects.

Each MDrivePlus on the bus will have a dedicated chip select. Only one system MDrivePlus can be communicated with/Parameters changed at a time.

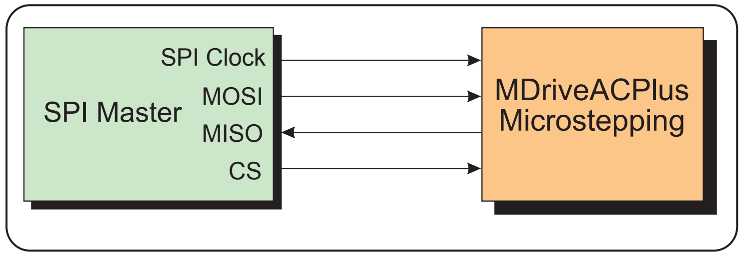


Figure 2.4.4: SPI Master with a Single MDrivePlus Microstepping

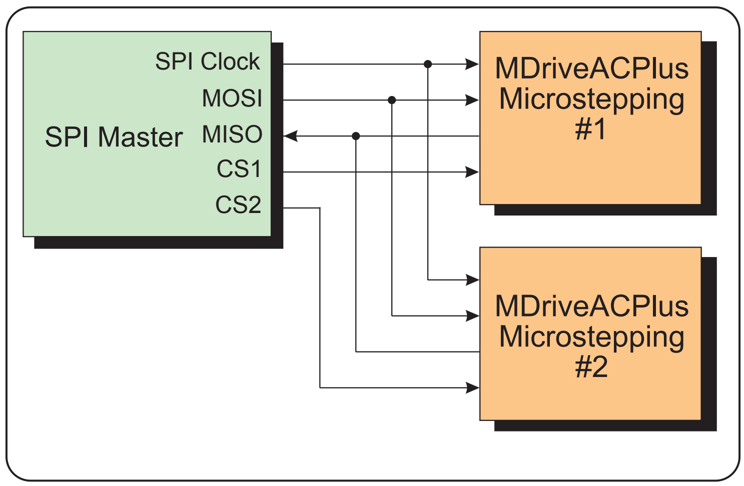


Figure 2.4.4: SPI Master with Multiple MDrivePlus Microstepping

Using the IMS SPI Motor Interface

Installation

The IMS SPI Motor Interface is a utility that easily allows you to set up the parameters of your MDrivePlus Microstepping. It is available both on the CD that came with your product and on the IMS web site at http://www.imshome.com/software_interfaces.html.

1. Insert the CD into the CD Drive of your PC.
   If not available, go to http://www.imshome.com/software_interfaces.html.
2. The CD will auto-start.
3. Click the Software Button in the top-right navigation Area.
4. Click the IMS SPI Interface link appropriate to your operating system.
5. Click SETUP in the Setup dialog box and follow the on-screen instructions.
6. Once IMS SPI Motor Interface is installed, the MDrivePlus Microstepping settings can be checked and/or set.

Configuration Parameters and Ranges

MDrivePlus Microstepping Setup Parameters				
Name	**Function**	**Range**	**Units**	**Default**
MHC	Motor Hold Current	0 to 100	percent	5
MRC	Motor Run Current	1 to 100	percent	25
MSEL	Microstep Resolution	1, 2, 4, 5, 8, 10, 16, 25, 32, 50, 64, 100,108, 125, 127,128, 180, 200, 250, 256	µsteps per full step	256
DIR	Motor Direction Override	0/1	–	CW
HCDT	Hold Current Delay Time	0 or 2-65535	mSec	500
CLK TYPE	Clock Type	Step/Dir. Quadrature, Up/Down (CW/CCW)	–	Step/Dir
CLK IOF	Clock and Direction Filter	50 nS to 12.9 µS (10 MHz to 38.8kHz)	nS (MHz)	50nS (10 MHz)
USER ID	User ID	Customizable	1-3 characters	IMS
EN ACT	Enable Active High/Low	High/Low	—	High
WARN TEMP	Warning Temperature	0 to + 125	°C	80

Table 2.5.1: Setup Parameters and Ranges

Color Coded Parameter Values

The SPI Motor Interface displays the parameter values using a predefined system of color codes to identify the status of the parameter.

1. Black: the parameter settings currently stored in the device NVM will display as black.
2. Blue: Blue text indicates a changed parameter setting that has not yet been written to the device.
3. Red: Red text indicates an out-of-range value which cannot be written to the device. When an out-of-range parameter is entered into a field, the "set" button will disable, preventing the value to be written to NVM. To view the valid parameter range, hover the mouse pointer over the field. The valid range will display in a tool tip.

The color coding is illustrated in Figure 2.5.1.

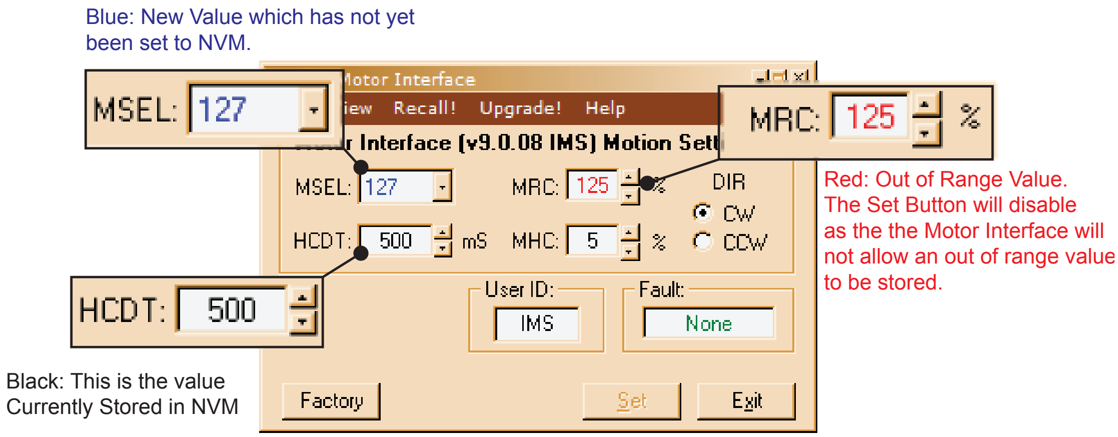


Figure 2.5.1: SPI Motor Interface Color Coding

IMS SPI Motor Interface Menu Options

File

> Open: Opens a saved *.mot (Motor Settings) file.

> Save: Saves the current motor settings as a *.mot file for later re-use

> Save As

> Exit - Disconnects from the device and opens the Initialization Dialog.

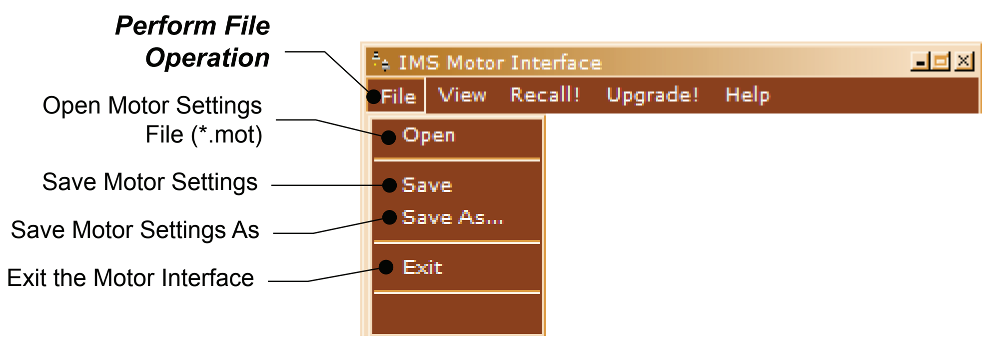


Figure 2.5.2: SPI Motor Interface File Menu

View

> Motion Settings: Displays the Motion Settings screen

> IO Settings: Displays the IO Settings Screen

> Part and Serial Number: Displays the part and serial number

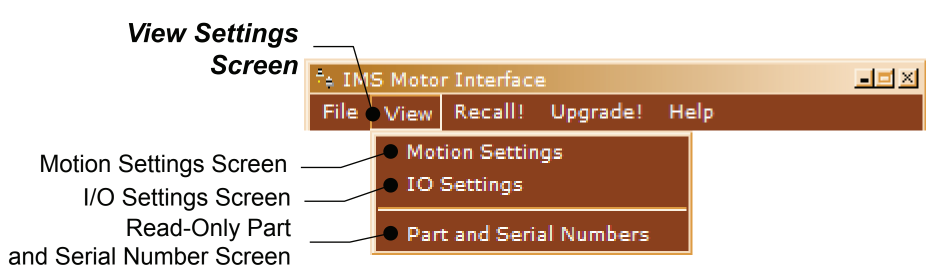


Figure 2.5.3: SPI Motor Interface View Menu

Recall!

Retrieves the settings from the MDrivePlus Microstepping.

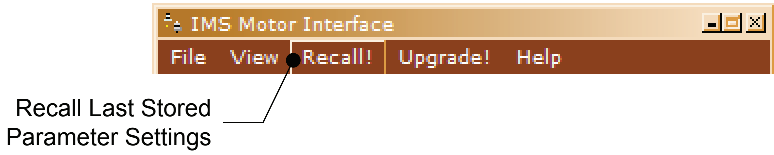


Figure 2.5.4: SPI Motor Interface Recall Menu

Upgrade!

Upgrades the MDrivePlus Microstepping firmware by placing the device in Upgrade Mode and launching the firmware upgrader utility.

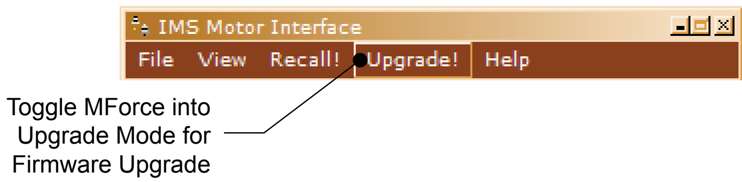


Figure 2.5.5: SPI Motor Interface Upgrade Menu

Help

> IMS Internet Tutorials: Link to an IMS Web Site page containing Interactive flash tutorials.

> About: Opens the About IMS and IMS SPI Motor Interface Screen.

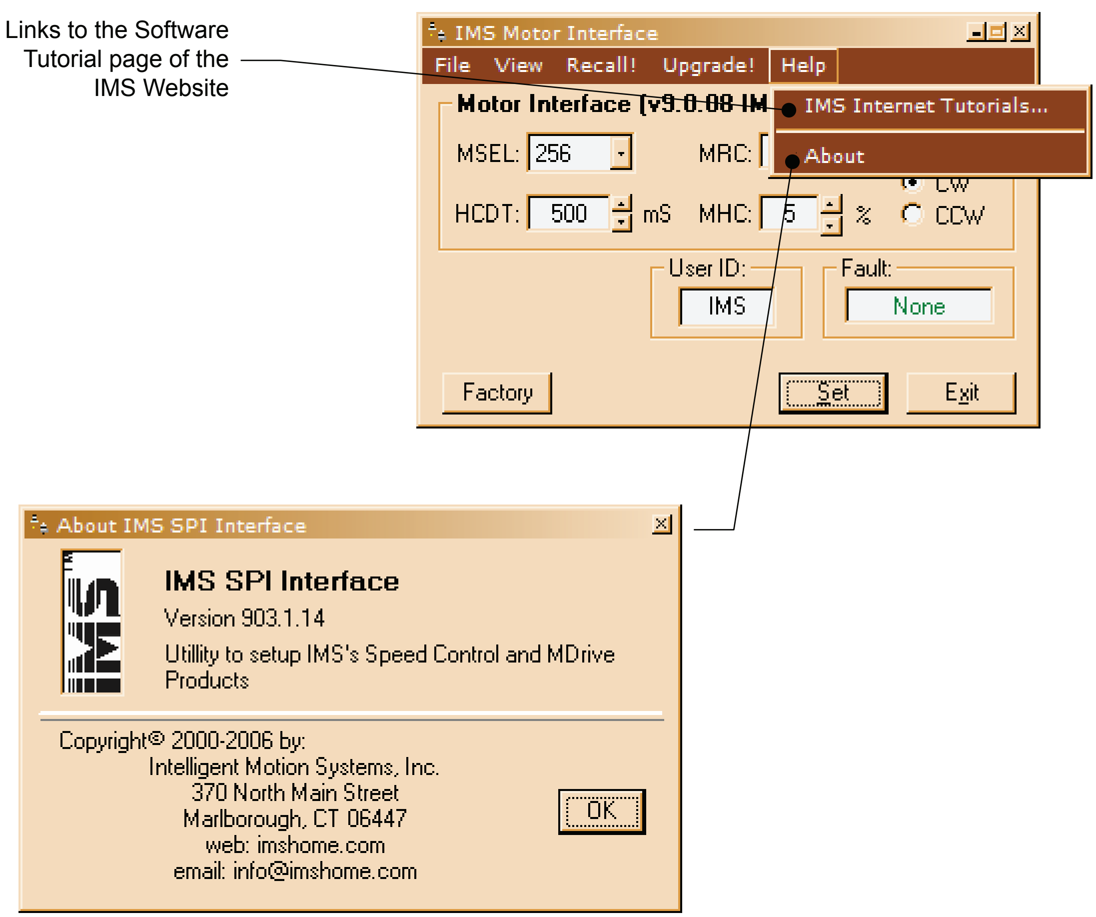


Figure 2.5.6: SPI Motor Interface Help Menu and About Screen

Screen 1: The Motion Settings Configuration Screen

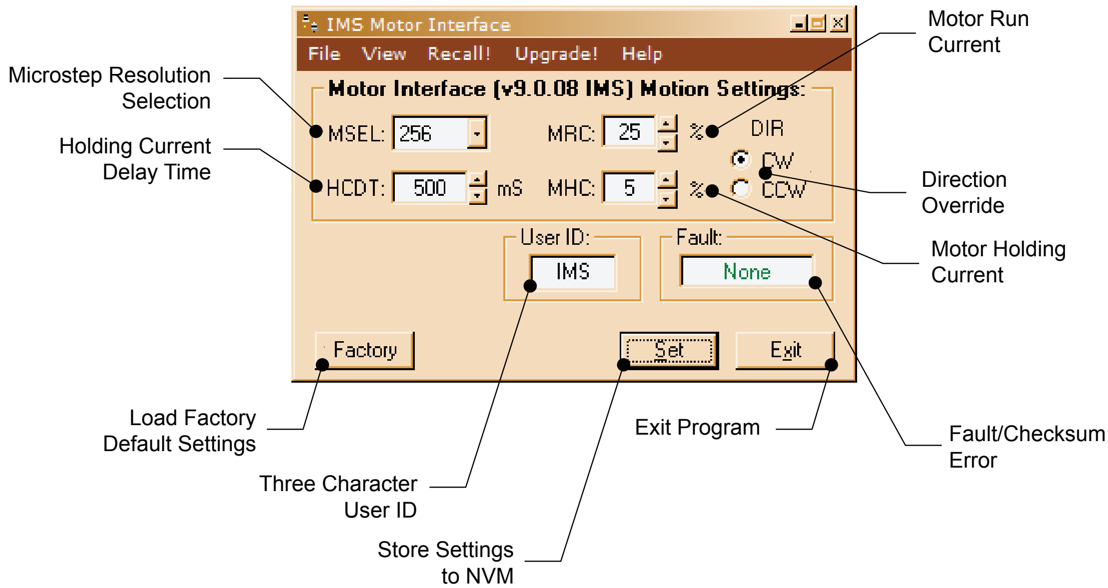


Figure 2.5.7: SPI Motor Interface Motion Settings Screen

The IMS SPI Motor Interface Software opens by default to the Motion Settings Screen shown on the left.

There are six basic parameters that may be set here:

1. MSEL: Microstep Resolution Select.
2. HCDT: Holding Current Delay Time.
3. MRC: Motor Run Current
4. Motor Holding Current
5. User ID: 3-character ID
6. Direction Override: Allows the user to set the CW/CCW direction of the motor in relation to the Direction Input from the SPI Motor Interface.

MSEL (Microstep Resolution Selection)

The MDrivePlus Microstepping features 20 microstep resolutions. This setting specifies the number of microsteps per step the motor will move.

The MDrivePlus uses a 200 step (1.8°) stepping motor which at the highest (default) resolution of 256 will yield 51,200 steps per revolution of the motor shaft.

See Table 2.3.2 for available Microstep Resolutions.

Microstep Resolution Settings			
Binary µStep Resolution Settings		Decimal µStep Resolution Settings	
MS=<µSteps/Step>	Steps/Revolution	MS=<µSteps/ Step>	Steps/Revolution
1	200	5	1000
2	400	10	2000
4	800	25	5000
8	1600	50	10000
16	3200	100	20000
32	6400	125	25000
64	12800	200	40000
128	25600	250	50000
256	51200		
Additional Resolution Settings			
180	36000 (0.01°/µStep)		
108	21600 (1 Arc Minute/µStep)		
127	25400 (0.001 mm/µStep)		

Table 2.5.2: Microstep Resolution Settings

HCDT (Hold Current Delay Time)

The HCDT Motor Hold Current Delay sets time in milliseconds for the Run Current to switch to Hold Current when motion is complete. When motion is complete, the MDrivePlus Microstepping will reduce the current in the windings of the motor to the percentage specified by MHC when the specified time elapses.

MRC (Motor Run Current)

The MRC Motor Run Current parameter sets the motor run current to a percentage of the full output current of the MDrivePlus driver section.

MHC (Motor Hold Current)

The MHC parameter sets the motor holding current as a percentage of the full output current of the driver. If the hold current is set to 0, the output circuitry of the driver section will disable when the hold current setting becomes active. The hold current setting becomes active HCDT setting mS following the last clock pulse.

DIR (Motor Direction)

The DIR Motor Direction parameter changes the motor direction relative to the direction input signal, adapting the direction of the MDrivePlus to operate as your system expects.

User ID

The User ID is a three character (viewable ASCII) identifier which can be assigned by the user. Default is IMS.

IMS SPI Motor Interface Button Functions

The following appear on all of the IMS SPI Motor Interface screens, but will only be documented here.

Factory

Clicking the Factory button will load the MDrivePlus Microstepping unit's factory default settings into the IMS SPI Motor Interface.

Connected/Disconnected Indicator

Displays the connected/disconnected state of the software , and if connected, the port connected on.

Set

Set writes the new settings to the MDrivePlus . Un-set settings will display as blue text in the setting fields. Once set they will be in black text. Setting the Parameters will also clear most Fault Conditions.

Exit

Disconnects and opens the Initialization dialog.

Screen 2: I/O Settings Configuration Screen

The I/O Settings screen may be accessed by clicking View > IO Settings on the menu bar. This screen is used to configure the Input Clock type, the filtering and the Active High/Low State of the Enable Input.

Input Clock Type

The Input Clock Type translates the specified pulse source that the motor will use as a reference for establishing stepping resolution based on the frequency.

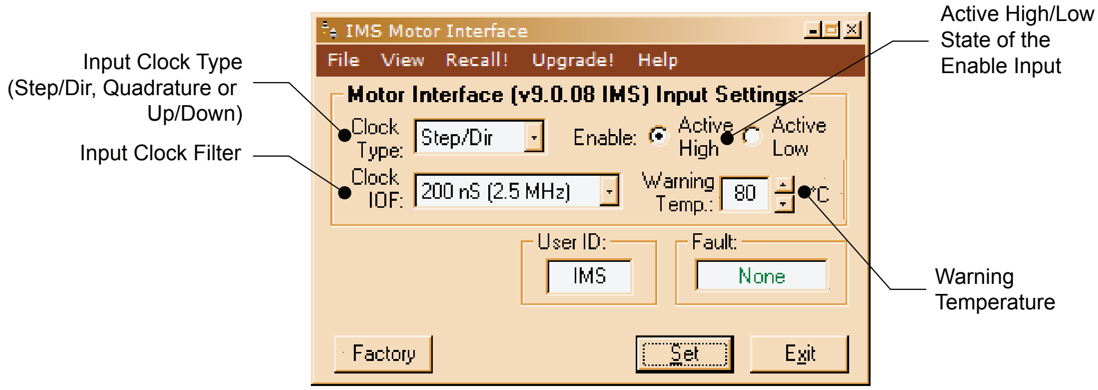


Figure 2.5.8: SPI Motor Interface I/O Settings Screen

The three clock types supported are:

1. Step/Direction
2. Quadrature
3. Up/Down (CW/CCW)

The Clock types are covered in detail in Section 2.2: Logic Interface and Connection.

Input Clock Filter

The clock inputs may also be filtered using the Clock IOF pull down of the IMS SPI Motor Interface. The filter range is from 50 nS (10 MHz) to 12.9 µSec. (38.8 kHz). Table 2.4.3 shows the filter settings.

Input Clock Filter Settings	
Min. Pulse	Cutoff Frequency
50 nS	10 MHz
150 nS	3.3 MHz
200 nS	2.5 MHz
300 nS	1.67 MHz
500 nS	1.0 MHz
900 nS	555 kHz
1.7 µS	294.1 kHz
3.3 µS	151 kHz
6.5 µS	76.9 kHz
12.9 µS	38.8 kHz

Table 2.5.3: Input Clock Filter Settings

Enable Active High/Low

The parameter sets the Enable Input to be Active when High (Default, Disconnected) or Active when Low.

Warning Temperature

The parameter sets the temperature at which a TW, or temperature warning fault code will be generated. In the warning condition the MDrivePlus will continue to operate as normal. The thermal shutdown is +85°C.

IMS Part Number/Serial Number Screen

The IMS Part Number and Serial Number screen is accessed by clicking "View > Part and Serial Numbers".

This screen is read-only and will display the part and serial number, as well as the fault code if existing. IMS may require this information if calling the factory for support.

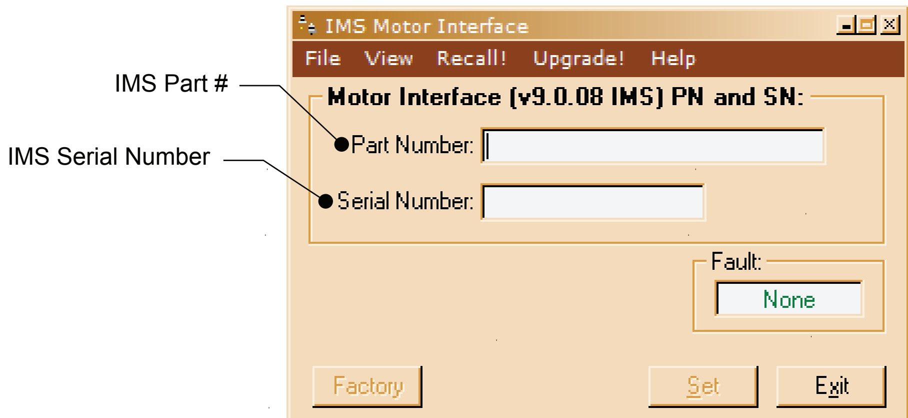


Figure 2.5.9: SPI Motor Interface Part and Serial Number Screen

Fault Indication

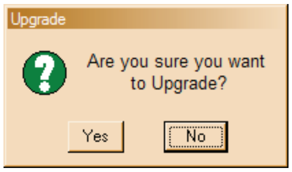
All of the IMS SPI Motor Interface Screens have the Fault field visible. This read-only field will display a 2 character error code to indicate the type of fault. The table below shows the error codes.

MDrive34Plus Microstepping Fault Codes				
Binary Case*	Error Code	Description	Action	To Clear
—	None	No Fault	—	—
4	CS	SPI Checksum Error	Error Displayed	Write to MDM (Set Button)
8	SC/CS	SPI Checksum Error/ Sector Changing	Error Displayed	Write to MDM (Set Button)
16	DFLT	Defaults Checksum Error	Error Displayed	Write to MDM (Set Button)
32	DATA	Settings Checksum Error	Error Displayed	Write to MDM (Set Button)
64	TW	Temperature Warning	Error Displayed	Write to MDM (Set Button)

*All Fault Codes are OR'ed together

Table 2.5.4: MDrivePlus Microstepping Fault Codes

NOTE: Once entered into Upgrade Mode, you MUST complete the upgrade. If the upgrade process is incomplete the IMS SPI Motor Interface will continue to open to the Upgrade dialog until the process is completed!



Upgrading the Firmware in the MDrivePlus Microstepping

The IMS SPI Upgrader Screen

New firmware releases are posted to the IMS web site at http://www.imshome.com.

The IMS SPI Motor Interface is required to upgrade your MDrivePlus Microstepping product. To launch the Upgrader, click "Upgrade!" on the IMS SPI Motor Interface menu.

The Upgrader screen has 4 read-only text fields that will display the necessary info about your MDrivePlus Microstepping.

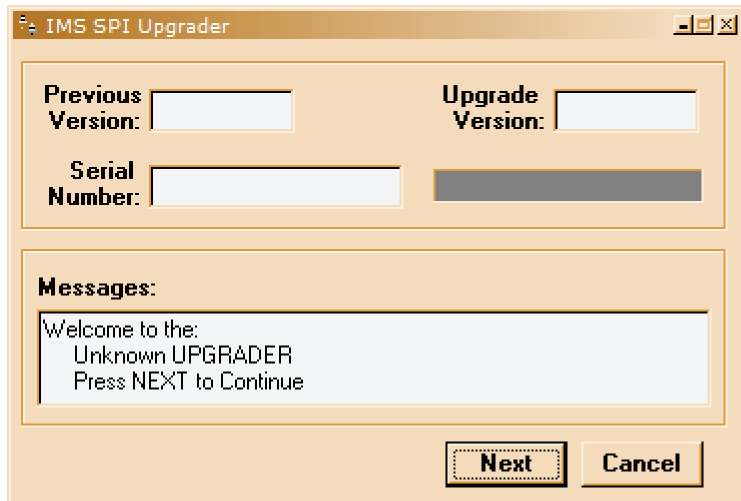


Figure 2.5.10: SPI Motor Interface Upgrade Utility

1. Previous Version: this is the version of the firmware currently on your MDrivePlus Microstepping.
2. Serial Number: the serial number of your unit.
3. Upgrade Version: will display the version number of the firmware being installed.
4. Messages: the messages text area will display step by step instructions through the upgrade process.

Upgrade Instructions

Below are listed the upgrade instructions as they will appear in the message box of the IMS SPI Upgrader. Note that some steps are not shown as they are accomplished internally, or are not relevant to the model IMS product you are updating. The only steps shown are those requiring user action.

```
Welcome Message: Welcome to the Motor Interface UPGRADER! Click NEXT to
continue.

Step 2: Select Upgrade File
```

When this loads, an explorer dialog will open asking you to browse for the firmware upgrade file. This file will have the extension *.ims.

```
Step 3: Connect SPI Cable
Step 4: Power up or Cycle Power to the MDrivePlus
Step 6: Press Upgrade Button
```

Progress bar will show upgrade progress in blue, Message box will read "Resetting Motor Interface"

```
Step 8: Press DONE, then select Port/Reconnect.
```

Initialization Screen

This screen will be active under five conditions:

1. When the program initially starts up and seeks for a compatible device.
2. The User selects File > Exit when connected to the device.
3. The User clicks the Exit button while connected to the device.
4. The Upgrade Process completes.
5. The SPI Motor Interface is unable to connect to a compatible device.

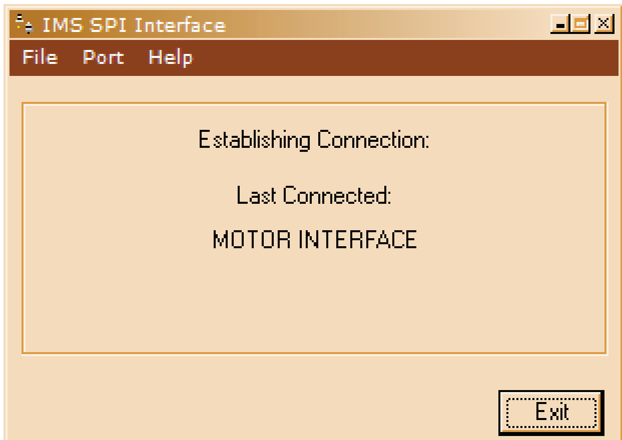


Figure 2.5.11: SPI Motor Interface Initialization

Port Menu

The Port Menu allows the user to select the COM Port that the device is connected to, either a parallel (LPT) Port, or a Hardware Serial or Virtual Serial Port via USB.

The Reconnect option allows the user to reconnect to a unit using the previously used settings.

On open or reconnect, the SPI Motor Interface will also try to auto seek for a connected device.

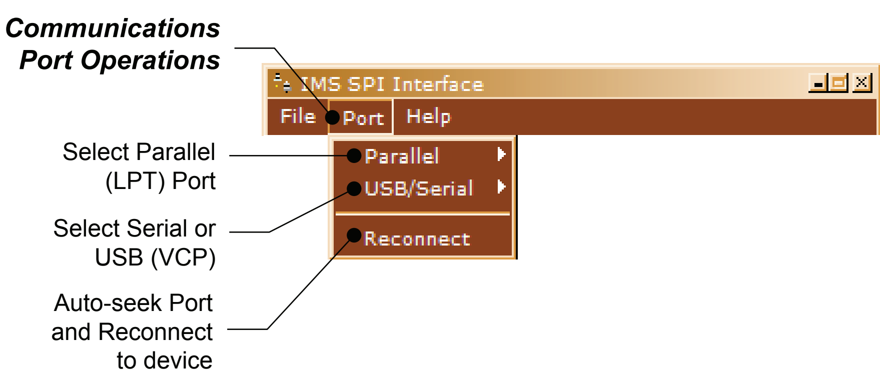


Figure 2.5.12: SPI Motor Interface Port Menu

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Using User-Defined SPI

The MDrivePlus can be configured and operated through the end-user's SPI interface without using the IMS SPI Motor Interface software and optional parameter setup cable.

An example of when this might be used is in cases where the machine design requires parameter settings to be changed on-the-fly by a software program or multiple system MDrivePlus Microstepping units parameter states being written/read.

SPI Timing Notes

1. MSb (Most Significant bit) first and MSB (Most Significant Byte) first.
2. 8 bit bytes.
3. 25 kHz SPI Clock (SCK).
4. Data In (MOSI) on rising clock.
5. Data Out (MISO) on falling clock.

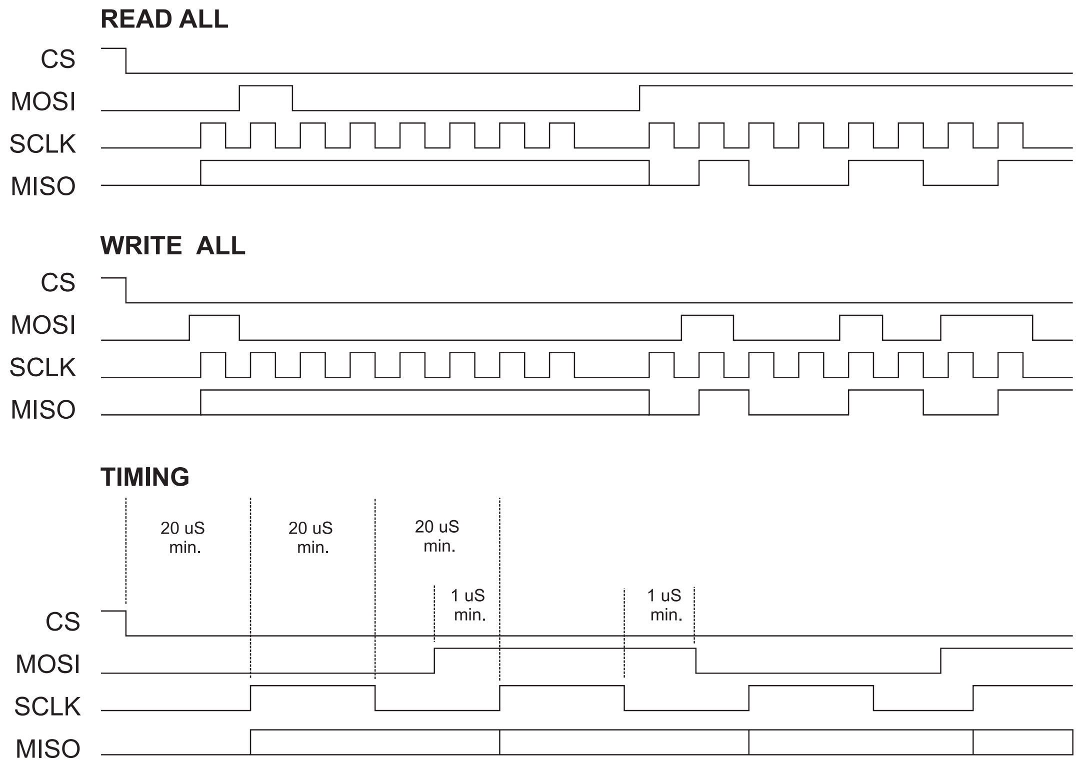


Figure 2.6.1: SPI Timing

Check Sum Calculation for SPI

The values in the example below are 8-bit binary hexadecimal conversions for the following SPI parameters: MRC=25%, MHC=5%, MSEL=256, HCDT=500 mSec, WARNTEMP=80.

The Check Sum is calculated as follows:

(Hex) 80+19+05+00+00+01+F4+50

Sum = E3	1110 0011
1's complement = 1C	0001 1100 (Invert)
2's complement = 1D	0001 1101 (Add 1)

Send the check sum value of 1D

Note: 80 is always the first command on a write.

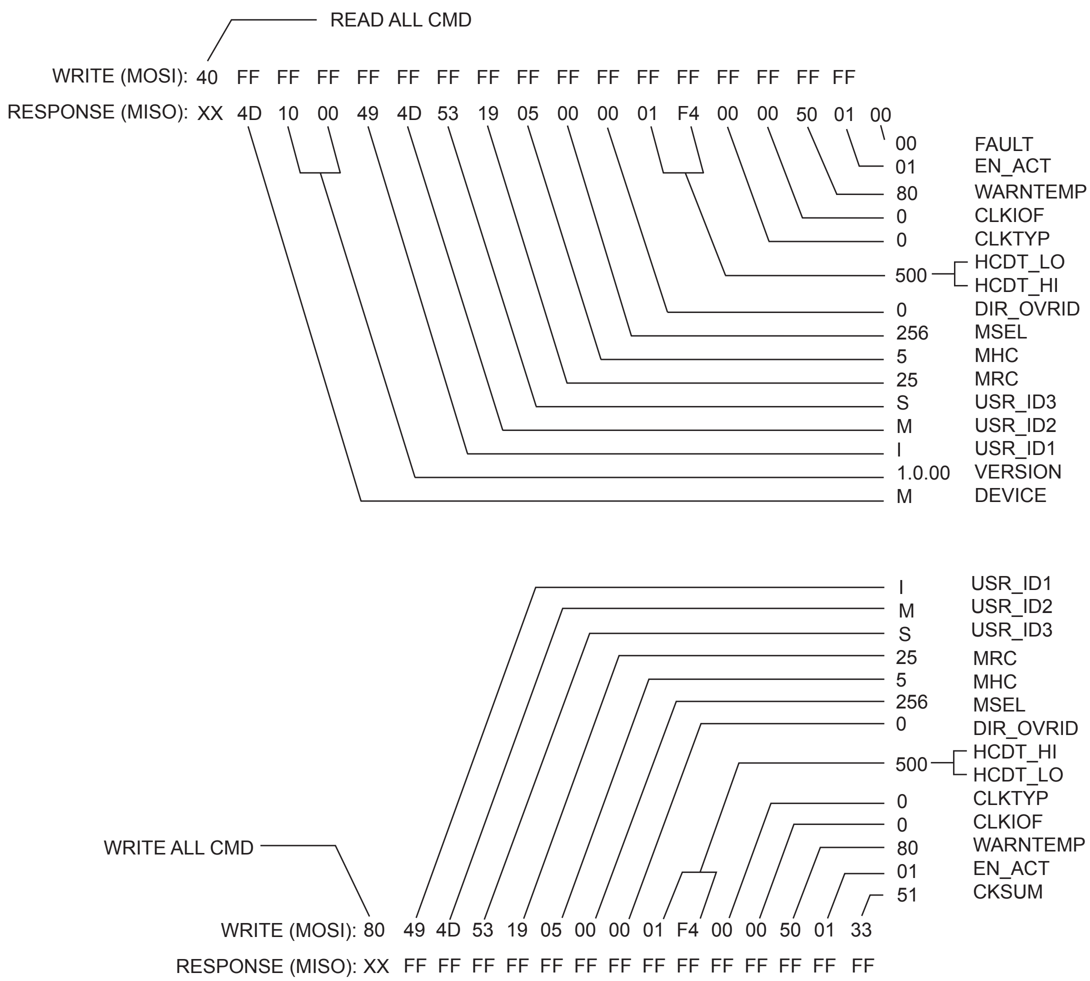
Note: Once a write is performed, a read needs to be performed to see if there is a fault. The fault is the last byte of the read.

SPI Commands and Parameters

Use the following table and figure found on the following page together as the Byte order read and written from the MDrivePlus Microstepping, as well as the checksum at the end of a WRITE is critical.

SPI Commands and Parameters				
	Command/ Parameter	HEX (Default)	Range	Notes
	READ ALL	0x40	—	Reads the hex value of all parameters
MSB	Device (M)	0x4D	—	M Character precedes every READ
	Version_MSB	0x10	<1-8>.<0-9>	Firmware Version.Sub-version, eg 1.0
	Version_LSB	0x00	<0-99>	Firmware Version Appends to Version_ MSB, eg.00
	USR_ID1	0x49	—	Uppercase Letter <I>
	USR_ID2	0x4D	—	Uppercase Letter <M>
	USR_ID3	0x53	—	Uppercase Letter <S>
	MRC	0x19	1-67%	Motor Run Current
	MHC	0x05	0-67%	Motor Hold Current
	MSEL	0x00	0*, 1-259 *0=256	Microstep Resolution (See Table in Section 2.4 for settings)
	DIR_OVRID	0x00	0=no override 1=override dir	Direction Override
	HCDT_HI	0x01	0 or 2-65535	Hold Current Delay Time High Byte
	HCDT_LO	0xF4		Hold Current Delay Time Low Byte
	CLKTYP	0x00	0=s/d, 1=quad, 2=u/d	Input Clock Type
	CLKIOF	0x00	<0-9>	Clock Input Filtering
	WARNTEMP	0x50		OVER_TEMP - 5° C
	EN_ACT	0x01	0=Low 1=High,	Enable Active High/Low
LSB	FAULT	0x00	—	See Fault Table, Section 2.4
	WRITE ALL	0x80	—	Writes the hex value to the following parameters.
MSB	USR_ID1	0x49	—	Uppercase Letter <I>
	USR_ID2	0x4D	—	Uppercase Letter <M>
	USR_ID3	0x53	—	Uppercase Letter <S>
	MRC	0x19	1-100%	Motor Run Current
	MHC	0x05	0-100%	Motor Hold Current
	MSEL	0x00	0*, 1-259 *0=256	Microstep Resolution (See Table in Section 2.4 for settings)
	DIR_OVRID	0x00	0=no override 1=override dir	Direction Override
	HCDT_HI	0x01	0 or 2-65535	Hold Current Delay Time High Byte
	HCDT_LO	0xF4		Hold Current Delay Time Low Byte
	CLKTYP	0x00	0=s/d, 1=quad, 2=u/d	Input Clock Type
	CLKIOF	0x00	<0-9>	Clock Input Filtering
	WARNTEMP	0x50		OVER_TEMP - 5° C
	EN_ACT	0x01	0=Low 1=High	Enable Active High/Low
LSB	CKSUM			34

Table 2.6.1: SPI Commands and Parameters



CHECKSUM CALCULATION

80+49+4D+53+19+05+00+00+01+F4+00+00+50+01=CD

BINARY = 1100 1101

1'S COMPLEMENT = 0011 0010

2'S COMPLEMENT = 0011 0011

DEC = 51

HEX = 33

Figure 2.6.2: Read/Write Byte Order for Parameter Settings (Default Parameters Shown)

SPI Communications Sequence

See Timing Diagram and Byte Order figures.

READ

1. Send READ ALL Command 0x40 down MOSI to MDrivePlus Microstepping followed by FF (15 Bytes).
2. Receive Parameter settings from MISO MSB First (M-Device) and ending with LSB (Fault).

Write

1. Send WRITE ALL Command (0x80) down MOSI followed by Parameter Bytes beginning with MSB (MRC) and ending with the LSB (Checksum of all parameter Bytes).
2. Response from MISO will be FF (10) Bytes.

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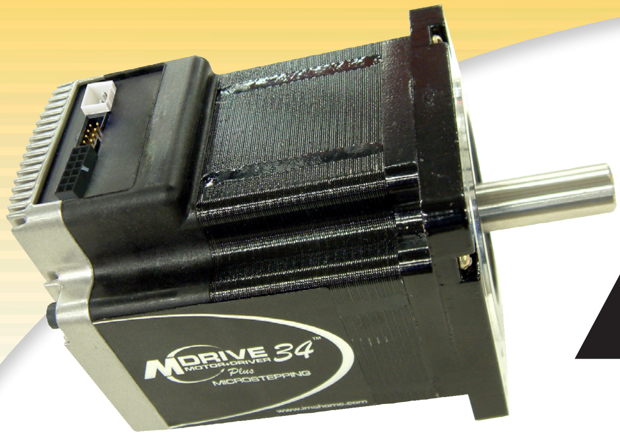

MDRIVE™ MOTOR+DRIVER Plus MICROSTEPPING

APPENDICES

Appendix A: MDrive34Plus Microstepping Motor Performance

Appendix B: Planetary Gearboxes

Appendix C: Connectivity

Appendix D: Interfacing an Encoder

Appendix E: Linear Slide Option

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MDrive34Plus Microstepping Motor Performance

Speed-Torque Curves

Single Length Rotary Motor

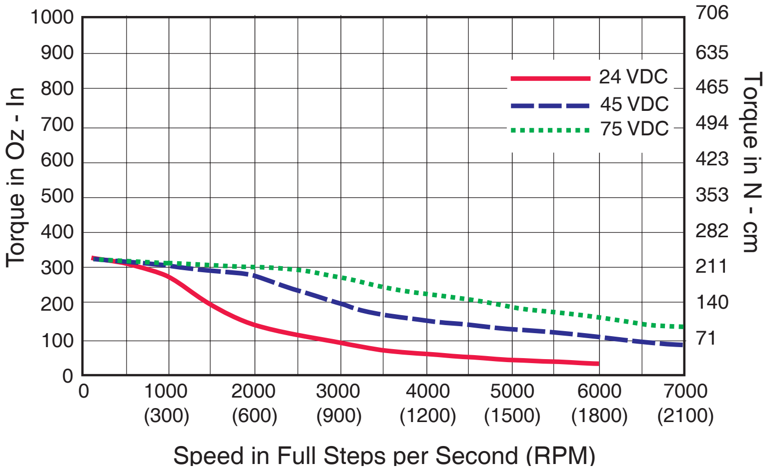


Figure A.1: MDrive34Plus Microstepping Single Length Speed-Torque Curves

Double Length Rotary Motor

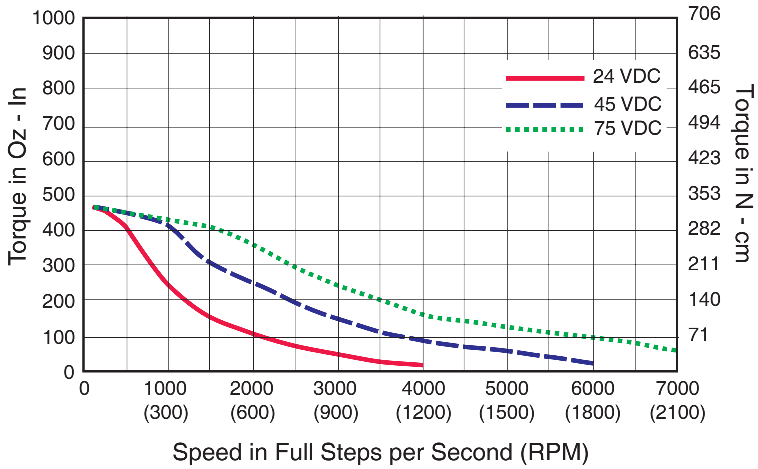


Figure A.2: MDrive34Plus Microstepping Double Length Speed-Torque Curves

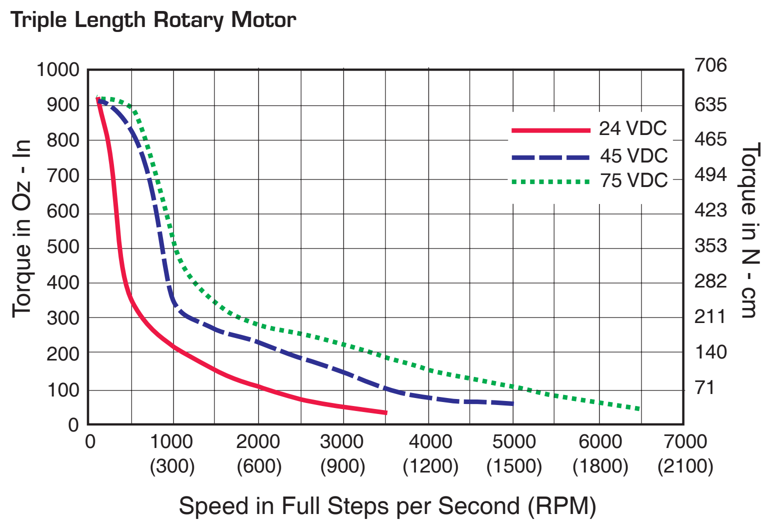


Figure A.3: MDrive34Plus Microstepping Triple Length Speed-Torque Curves

Motor Specifications

Single Length

Holding Torque....................................381 oz-in/269 N-cm
Detent Torque....................................10.9 oz-in/7.7 N-cm
Rotor Inertia ....0.01416 oz-in-sec^2/1.0 kg-cm^2
Weight (Motor + Driver)....................................4.1 lb/1.9 kg

Double Length

Holding Torque....................................575 oz-in/406 N-cm
Detent Torque....................................14.16 oz-in/14.0 N-cm
Rotor Inertia ....0.02266 oz-in-sec^2/1.6 kg-cm^2
Weight (Motor + Driver)....................................5.5 lb/2.5 kg

Triple Length

Holding Torque....................................1061 oz-in/749 N-cm
Detent Torque....................................19.83 oz-in/10.0 N-cm
Rotor Inertia ....0.04815 oz-in-sec^2/3.4 kg-cm^2
Weight (Motor + Driver)....................................8.8 lb/4.0 kg

Planetary Gearboxes

Section Overview

This section contains guidelines and specifications for MDrives equipped with an optional Planetary Gearbox, and may include product sizes not relevant to this manual.

Shown are:

- Product Overview
- Selecting a Planetary Gearbox
- Mechanical Specifications

Product Overview

All gearboxes are factory installed.

Mode of Function

Optional Planetary Gearbox operate as their name implies: the motor-driven sun wheel is in the center, transmitting its movement to three circumferential planet gears which form one stage. They are arranged on the bearing pins of a planet carrier. The last planet carrier in each sequence is rigidly linked to the output shaft and so ensures the power transmission to the output shaft. The planet gears run in an internally toothed outer ring gear.

Service Life

Depending on ambient and environmental conditions and the operational specification of the driving system, the useful service life of a Planetary Gearbox is up to 10,000 hours. The wide variety of potential applications prohibits generalizing values for the useful service life.

Lubrication

All Planetary Gearbox are grease-packed and therefore maintenance-free throughout their life. The best possible lubricant is used for our MDrive/Planetary Gearbox combinations.

Mounting Position

The grease lubrication and the different sealing modes allow the Planetary Gearbox to be installed in any position.

Operating Temperature

The temperature range for the Planetary Gearbox is between –30 and +140° C. However, the temperature range recommended for the Heat Sink of the MDrive is -40 to +85º C.

Overload Torque

The permitted overload torque (shock load) is defined as a short-term increase in output torque, e.g. during the start-up of a motor. In these all-metal Planetary Gearbox, the overload torque can be as much as 1.5 times the permitted output torque.

Available Planetary Gearbox

The following lists available Planetary Gearbox, diameter and corresponding MDrive.

Gearbox Diameter	MDrive
81 mm	MDrive34Plus

Selecting a Planetary Gearbox

There are many variables and parameters that must be considered when choosing an appropriate reduction ratio for an MDrive with Planetary Gearbox. This Addendum includes information to assist in determining a suitable combination for your application.

Calculating the Shock Load Output Torque (T_{AB})

Note: The following examples are based on picking "temporary variables" which may be adjusted.

The shock load output torque (T_{AB}) is not the actual torque generated by the MDrive and Planetary Gearbox combination, but is a calculated value that includes an operating factor (C_B) to compensate for any shock loads applied to the Planetary Gearbox due to starting and stopping with no acceleration ramps, payloads and directional changes. The main reason the shock load output torque (T_{AB}) is calculated is to ensure that it does not exceed the maximum specified torque for a Planetary Gearbox.

Note: There are many variables that affect the calculation of the shock load output torque. Motor speed, motor voltage, motor torque and reduction ratio play an important role in determining shock load output torque. Some variables must be approximated to perform the calculations for the first time. If the result does not meet your requirements, change the variables and re-calculate the shock load output torque. Use the equation compendium below to calculate the shock load output torque.

Factors

i	=	Reduction Ratio - The ratio of the Planetary Gearbox.
n_M	=	Motor Speed - In Revolutions Per Minute (Full Steps/Second).
n_{AB}	=	Output Speed - The speed at the output shaft of the Planetary Gearbox.
T_N	=	Nominal Output Torque - The output torque at the output shaft of the Planetary Gearbox.
T_M	=	Motor Torque - The base MDrive torque. Refer to MDrive Speed Torque Tables.
η	=	Gear Efficiency - A value factored into the calculation to allow for any friction in the gears.
T_{AB}	=	Shock Load Output Torque - A torque value calculated to allow for short term loads greater than the nominal output torque.
C_B	=	Operating Factor - A value that is used to factor the shock load output torque.
s_f	=	Safety Factor - A 0.5 to 0.7 factor used to create a margin for the MDrive torque requirement.

Reduction Ratio

Reduction ratio (i) is used to reduce a relatively high motor speed (n_M) to a lower output speed (n_{AB}).

With: $i = n_M \div n_{AB}$ or: motor speed ÷ output speed = reduction ratio

Example:

The required speed at the output shaft of the Planetary Gearbox is 90 RPM.

You would divide motor speed (n_M) by output speed (n_{AB}) to calculate the proper gearbox ratio.

The MDrive speed you would like to run is approximately 2000 full steps/second or 600 RPM.

NOTE: In reference to the MDrive speed values, they are given in full steps/second on the Speed/Torque Tables. Most speed specifications for the Planetary Gearbox will be given in RPM (revolutions per minute). To convert full steps/second to RPM, divide by 200 and multiply by 60.

Where: 200 is the full steps per revolution of a 1.8° stepping motor.

2000 full steps/second ÷ 200 = 10 RPS (revolutions per second) × 60 Seconds = 600 RPM

For the Reduction Ratio (i), divide the MDrive speed by the required Planetary Gearbox output speed.

600 RPM ÷ 90 = 6.67:1 Reduction Ratio

Referring to the Available Ratio Table at the end of this section, the reduction ratio (i) of the Planetary Gearbox will be 7:1. The numbers in the left column are the rounded ratios while the numbers in the right column are the actual ratios. The closest actual ratio is 6.75:1 which is the rounded ratio of 7:1. The slight difference can be made up in MDrive speed.

Nominal Output Torque

Calculate the nominal output torque using the torque values from the MDrive's Speed/Torque Tables.

Nominal output torque (T_N) is the actual torque generated at the Planetary Gearbox output shaft which includes reduction ratio (i), gear efficiency (η) and the safety factor (s_f) for the MDrive. Once the reduction ratio (i) is determined, the nominal output torque (T_N) can be calculated as follows:

$T_N = T_M \times i \times \eta \div s_f$ or:

Motor torque × reduction ratio × gear efficiency ÷ safety factor = nominal output torque.

For gear efficiency (η) refer to the Mechanical Specifications for the 7:1 Planetary Gearbox designed for your MDrive.

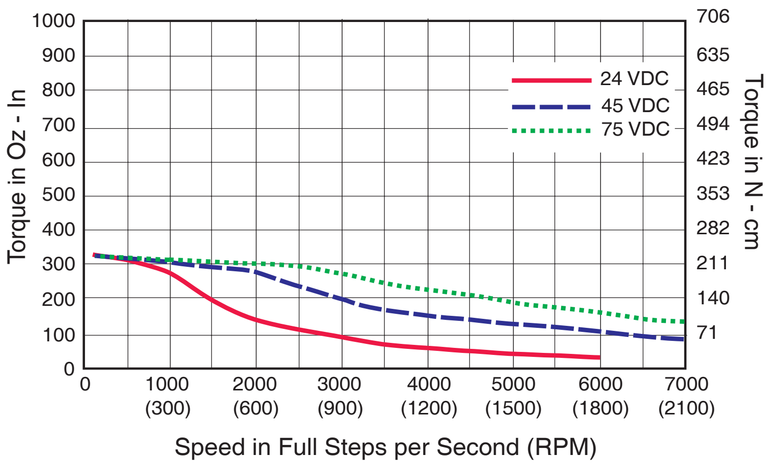


Figure B.1: MDrive34 Torque-Speed Curve

For motor torque (T_M) see the appropriate MDrive Speed/Torque Table. Dependent on which MDrive you have, the torque range will vary. The torque will fall between the high voltage line and the low voltage line at the indicated speed for the MDrive. (See the example Speed/Torque Table below.)

The Speed/Torque Table above is for an MDrive23 Double Length Motor. This MDrive will produce a torque range of 51 to 95 oz-in in the full voltage range at the speed of 2000 Full Steps/Second (600 RPM).

Please note that this is not the usable torque range. The torque output to the Planetary Gearbox must include a safety factor (s_f) to allow for any voltage and current deviations supplied to the MDrive.

The motor torque must include a safety factor (s_f) ranging from 0.5 to 0.7. This must be factored into the nominal output torque calculation. A 0.5 safety factor is aggressive while a 0.7 safety factor is more conservative.

Example:

The available motor torque (T_M) is 51 to 95 oz-in.

NOTE: You may specify a torque less than but not greater than the motor torque range.

For this example the motor torque (T_M) will be 35 oz-in.

A 6.75:1 reduction ratio (i) has been determined.

Gear efficiency (η) = 80% from the appropriate table for the Planetary Gearbox which is used with an MDrive23.

Nominal output torque would be:

Motor torque (T_M = 35) × reduction ratio (i = 6.75) × gear efficiency (η = 0.8) ÷ safety factor (s_f = 0.5 or 0.7)

35 × 6.75 = 236.25 × 0.8 = 189 ÷ 0.5 = 378 oz-in nominal output torque (T_N)

or

35 × 6.75 = 236.25 × 0.8 = 189 ÷ 0.7 = 270 oz-in nominal output torque (T_N)

With the safety factor (s_f) and gear efficiency (η) included in the calculation, the nominal output torque (T_N) may be greater than the user requirement.

Shock Load Output Torque

The nominal output torque (T_N) is the actual working torque the Planetary Gearbox will generate. The shock load output torque (T_{AB}) is the additional torque that can be generated by starting and stopping with no acceleration ramps, payloads, inertia and directional changes. Although the nominal output torque (T_N) of the Planetary Gearbox is accurately calculated, shock loads can greatly increase the dynamic torque on the Planetary Gearbox.

Each Planetary Gearbox has a maximum specified output torque. In this example a 7:1 single stage MD23 Planetary Gearbox is being used. The maximum specified output torque is 566 oz-in. By calculating the shock load output torque (T_{AB}) you can verify that value is not exceeding the maximum specified output torque.

When calculating the shock load output torque (T_{AB}), the calculated nominal output torque (T_N) and the operating factor (C_B) are taken into account. C_B is merely a factor which addresses the different working conditions of a Planetary Gearbox and is the result of your subjective appraisal. It is therefore only meant as a guide value. The following factors are included in the approximate estimation of the operating factor (C_B):

- Direction of rotation (constant or alternating)
- Load (shocks)
- Daily operating time

Note: The higher the operating factor (C_B), the closer the shock load output torque (T_{AB}) will be to the maximum specified output torque for the Planetary Gearbox. Refer to the table below to calculate the approximate operating factor (C_B).

With the most extreme conditions which would be a C_B of 1.9, the shock load output torque (T_{AB}) is over the maximum specified torque of the Planetary Gearbox with a 0.5 safety factor but under with a 0.7 safety factor.

The nominal output torque (T_N) × the operating factor (C_B) = shock load or maximum output torque (T_{AB}).

With a 0.5 safety factor, the shock load output torque is greater than the maximum output torque specification of the MDrive23 Planetary Gearbox.

(378 × 1.9 = 718.2 oz-in.)

With a 0.7 safety factor the shock load output torque is within maximum output torque specification of the MDrive23 Planetary Gearbox.

(270 × 1.9 = 513 oz-in.)

The 0.5 safety factor could only be used with a lower operating factor (C_B) such as 1.5 or less, or a lower motor torque.

Note: All published torque specifications are based on C_B = 1.0. Therefore, the shock load output torque (T_{AB}) = nominal output torque (T_N).

WARNING! Excessive torque may damage your Planetary Gearbox. If the MDrive/Planetary Gearbox should hit an obstruction, especially at lower speeds (300 RPM or 1000 Full Steps/Second), the torque generated will exceed the maximum torque for the Planetary Gearbox. Precautions must be taken to ensure there are no obstructions in the system.

Determining the Operating Factor (C_B)				
Direction of Rotation	Load (Shocks)	Daily Operating Time		
		3 Hours	8 Hours	24 Hours
Constant	Low*	C_B=1.0	C_B=1.1	C_B=1.3
	Medium**	C_B=1.2	C_B=1.3	C_B=1.5
Alternating	Low†	C_B=1.3	C_B=1.4	C_B=1.6
	Medium††	C_B=1.6	C_B=1.7	C_B=1.9

* Low Shock = Motor turns in one direction and has ramp up at start.
** Medium Shock = Motor turns in one direction and has no ramp up at start.
† Low Shock = Motor turns in both directions and has ramp up at start.
†† Medium Shock = Motor turns in both directions and has no ramp up at start.

Table B.1: Planetary Gearbox Operating Factor

System Inertia

System inertia must be included in the selection of an MDrive and Planetary Gearbox. Inertia is the resistance an object has relative to changes in velocity. Inertia must be calculated and matched to the motor inertia. The Planetary Gearbox ratio plays an important role in matching system inertia to motor inertia. There are many variable factors that affect the inertia. Some of these factors are:

- The type of system being driven.
- Weight and frictional forces of that system.
- The load the system is moving or carrying.

The ratio of the system inertia to motor inertia should be between 1:1 and 10:1. With 1:1 being ideal, a 1:1 to 5:1 ratio is good while a ratio greater than 5:1 and up to 10:1 is the maximum.

Type of System

There are many systems and drives, from simple to complex, which react differently and possess varied amounts of inertia. All of the moving components of a given system will have some inertia factor which must be included in the total inertia calculation. Some of these systems include:

- Lead screw
- Rack and pinion
- Conveyor belt
- Rotary table
- Belt drive
- Chain drive

Not only must the inertia of the system be calculated, but also any load that it may be moving or carrying. The examples below illustrate some of the factors that must be considered when calculating the inertia of a system.

Lead Screw

In a system with a lead screw, the following must be considered:

- The weight and preload of the screw
- The weight of the lead screw nut
- The weight of a table or slide
- The friction caused by the table guideways
- The weight of any parts

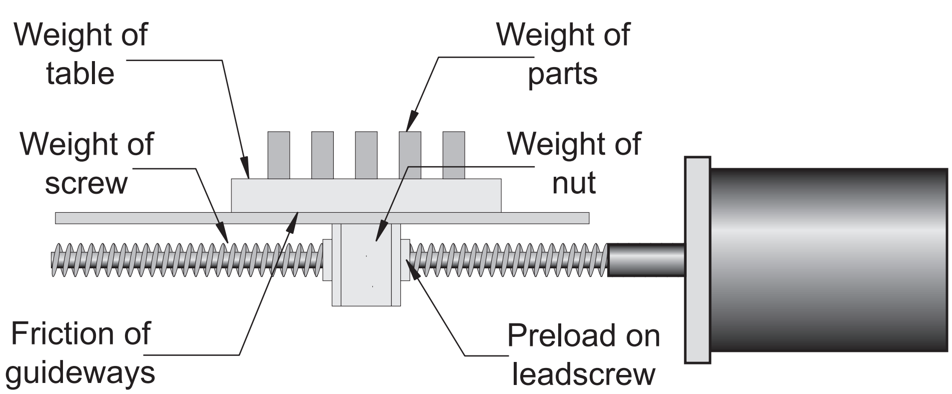


Figure B.2: Lead Screw System Inertia Considerations

Rack and Pinion

In a system with a rack and pinion, the following must be considered:

- The weight or mass of the pinion
- The weight or mass of the rack
- The friction and/or preload between the pinion and the rack
- Any friction in the guidance of the rack
- The weight or mass of the object the rack is moving

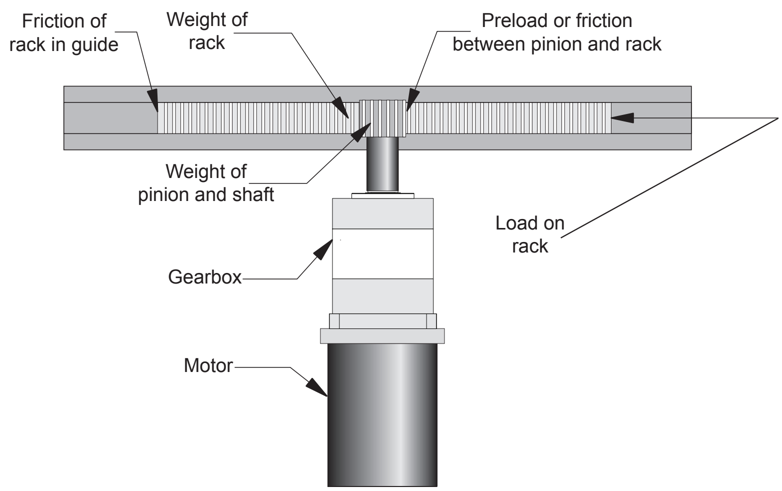


Figure B.3: Rack and Pinion System Inertia Considerations

Conveyor Belt

In a system with a conveyor belt, the following must be considered:

- The weight and size of the cylindrical driving pulley or roller
- The weight of the belt
- The weight or mass and size of the idler roller or pulley on the opposite end
- The angle or elevation of the belt
- Any load the belt may be carrying

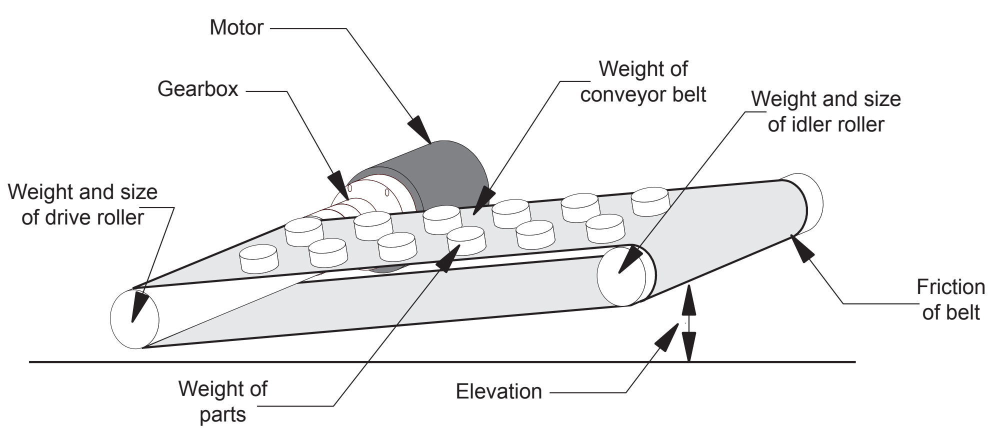


Figure B.4: Conveyor System Inertia Considerations

Rotary Table

In a system with a rotary table, the following must be considered:

- The weight or mass and size of the table
- Any parts or load the table is carrying
- The position of the load on the table, the distance from the center of the table will affect the inertia
- How the table is being driven and supported also affects the inertia

Belt Drive

In a system with a belt drive, the following must be considered:

- The weight or mass and size of the driving pulley
- The tension and/or friction of the belt
- The weight or mass and size of the driven pulley
- Any load the system may be moving or carrying

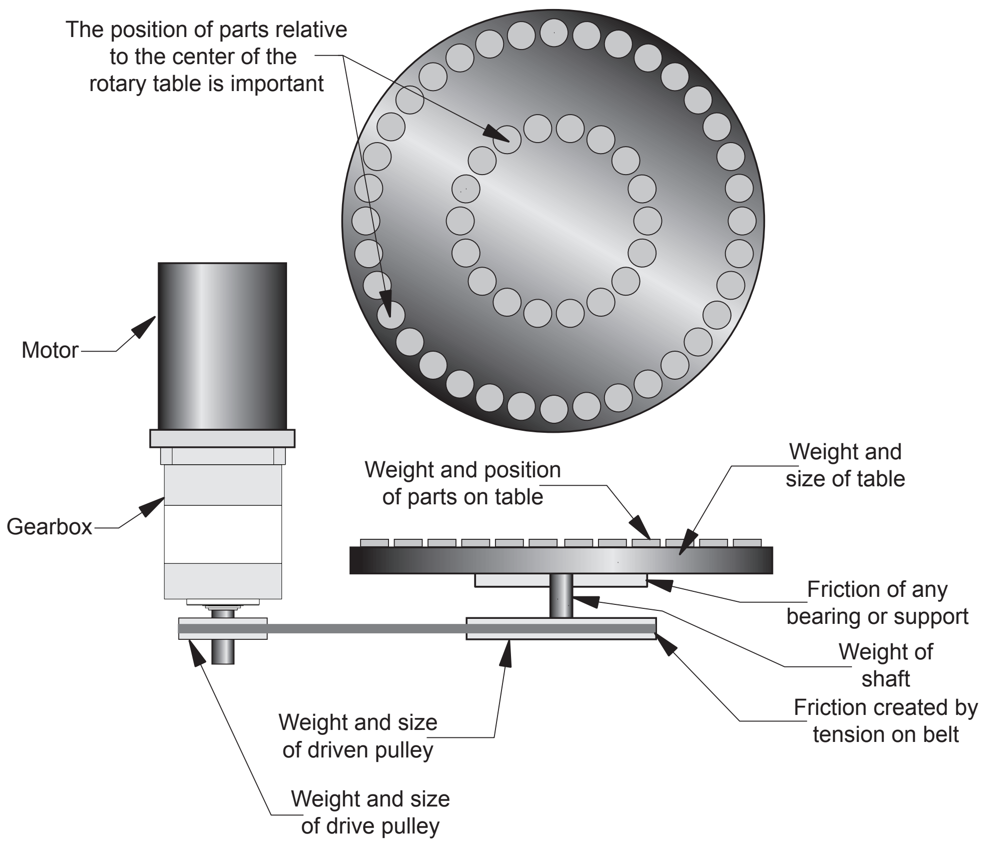


Figure B.5: Rotary Table System Inertia Considerations

Chain Drive

In a system with a chain drive, the following must be considered:

- the weight and size of drive sprocket and any attaching hub
- the weight and size of the driven sprocket and shaft
- the weight of the chain
- the weight of any material or parts being moved

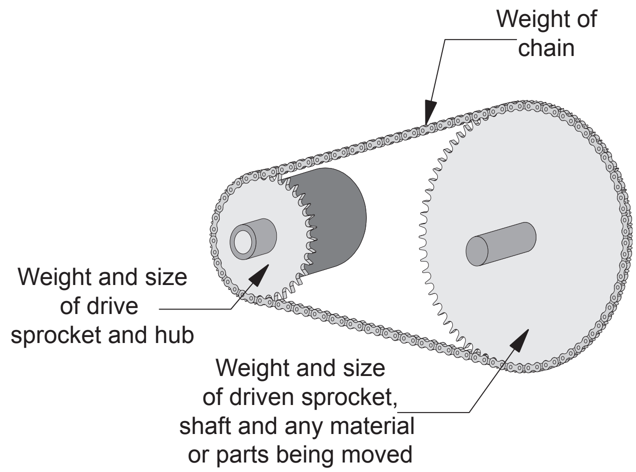


Figure B.6: Chain Drive System Inertia Considerations

Once the system inertia (J_L) has been calculated in oz-in-sec^2, it can be matched to the motor inertia. To match the system inertia to the motor inertia, divide the system inertia by the square of the gearbox ratio. The result is called Reflected Inertia or (J_{ref}).

$$J_{ref} = J_L \div Z^2$$

Where:

J_L = System Inertia in oz-in-sec^2

J_{ref} = Reflected Inertia in oz-in-sec^2

Z = Gearbox Ratio

The ideal situation would be to have a 1:1 system inertia to motor inertia ratio. This will yield the best positioning and accuracy. The reflected inertia (J_{ref}) must not exceed 10 times the motor inertia.

Your system may require a reflected inertia ratio as close to 1:1 as possible. To achieve the 1:1 ratio, you must calculate an Optimal Gearbox Ratio (Z_{opt}) which would be the square root of J_L divided by the desired J_{ref}. In this case since you want the system inertia to match the motor inertia with a 1:1 ratio, J_{ref} would be equal to the motor inertia.

$$Z_{opt} = \quad J_L \div J_{ref}$$

Where:

Z_{opt} = Optimal Gearbox Ratio

J_L = System Inertia in oz-in-sec^2

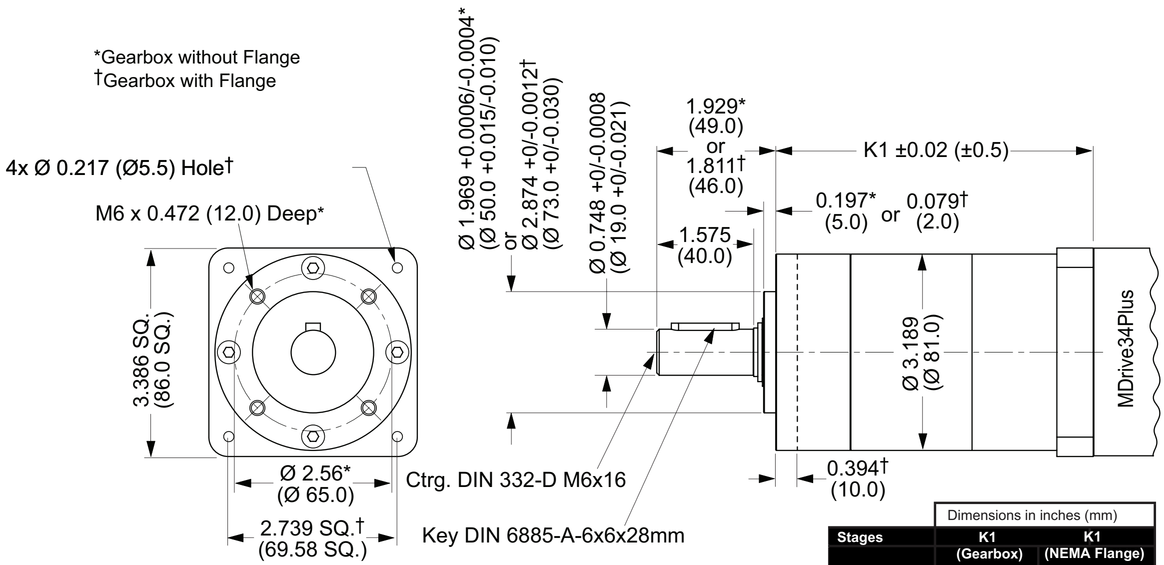
J_{ref} = Desired Reflected Inertia in oz-in-sec^2 (Motor Inertia)

Planetary Gearbox for MDrive34Plus

MDrive34Plus Planetary Gearbox Parameters

	Permitted Output Torque (oz-in/Nm)	Gearbox Efficiency	Maximum Backlash	Output Side with Ball Bearing			
				Maximum Load (lb-force/N)		Weight (oz/g)	
				Radial	Axial	Gearbox	with Flange
1-STAGE	2832/20.0	0.80	1.0°	90/400	18/80	64.4/1827	66.7/1890
2-STAGE	8496/60.0	0.75	1.5°	135/600	27/120	89.5/2538	92.6/2625
3-STAGE	16992/120.0	0.70	2.0°	225/1000	45/200	92.6/2625	118.5/3360

Table B.2: Planetary Gearbox Specifications – PM81



Stages	K1 (Gearbox)	K1 (NEMA Flange)
	Dimensions in inches (mm)	
1-Stage	4.315 (109.6)	4.433 (112.6)
2-Stage	5.169 (131.3)	5.287 (134.3)
3-Stage	6.024 (153.0)	6.142 (156.0)

Figure B.7: Planetary Gearbox Specifications for MDrive34Plus

PM81 Gearbox Ratios and Part Numbers

Planetary Gearbox	Ratio (Rounded)	Inertia Moments	Part Number
1-Stage	3.71:1	0.00233660	G1A1
1-Stage	5.18:1	0.00154357	G1A2
1-Stage	6.75:1	0.00128867	G1A3
2-Stage	13.73:1	0.00219499	G1A4
2-Stage	15.88:1	0.00179847	G1A5
2-Stage	18.37:1	0.00182679	G1A6
2-Stage	19.20:1	0.00141612	G1A7
2-Stage	22.21:1	0.00148693	G1A8
2-Stage	25.01:1	0.00177015	G1A9
2-Stage	26.85:1	0.00148693	G1B1
2-Stage	28.93:1	0.00124619	G1B2
2-Stage	34.98:1	0.001260345	G1B3
2-Stage	45.56:1	0.00126035	G1B4

Planetary Gearbox	Ratio (Rounded)	Inertia Moments	Part Number
3-Stage	50.89:1	0.00218082	G1B5
3-Stage	58.86:1	0.00178431	G1B6
3-Stage	68.07:1	0.00179847	G1B7
3-Stage	71.16:1	0.00147276	G1B8
3-Stage	78.72:1	0.00179847	G1B9
3-Stage	92.70:1	0.00124619	G1C1
3-Stage	95.18:1	0.00147276	G1C2
3-Stage	99.51:1	0.00148693	G1C3
3-Stage	107.21:1	0.00124619	G1C4
3-Stage	115.08:1	0.00148693	G1C5
3-Stage	123.98:1	0.00124619	G1C6
3-Stage	129.62:1	0.00124619	G1C7
3-Stage	139.14:1	0.00144444	G1C8
3-Stage	149.90:1	0.00124619	G1C9
3-Stage	168.85:1	0.00126035	G1D1
3-Stage	181.25:1	0.00124619	G1D2
3-Stage	195.27:1	0.00126035	G1D3
3-Stage	236.10:1	0.00126035	G1D4
3-Stage	307.55:1	0.00126035	G1D5

Table B.3: Planetary Gearbox Ratios, Inertia Moments and Part Numbers

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WARNING! DO NOT connect or disconnect the MD-CC300-001 Communications Converter Cable from MDrive while power is applied!

MD-CC30x-001: USB to SPI Converter and Parameter Setup Cable

The MD-CC30x-001 USB to SPI Parameter Setup Cable provides a communication connection between the Microstepping MDrives and the USB port on a PC.

IMS SPI Interface Software communicates to the Parameter Setup Cable through the PC's USB port.

The Parameter Setup Cable interprets SPI commands and sends these commands to the MDrivePlus through the SPI interface.

Supplied Components: MD-CC30 communications converter, Parameter Setup Cable, USB Cable, USB Drivers, IMS SPI Interface Software.

MD-CC300-001

The MD-CC300-001 interfaces to the model MDrivePlus Microstepping with a 10-Pin IDC type connector at location P2.

NEMA 17 Size MDrivePlus Microstepping shown in Figure below. Connection for a NEMA 23 will be identical.

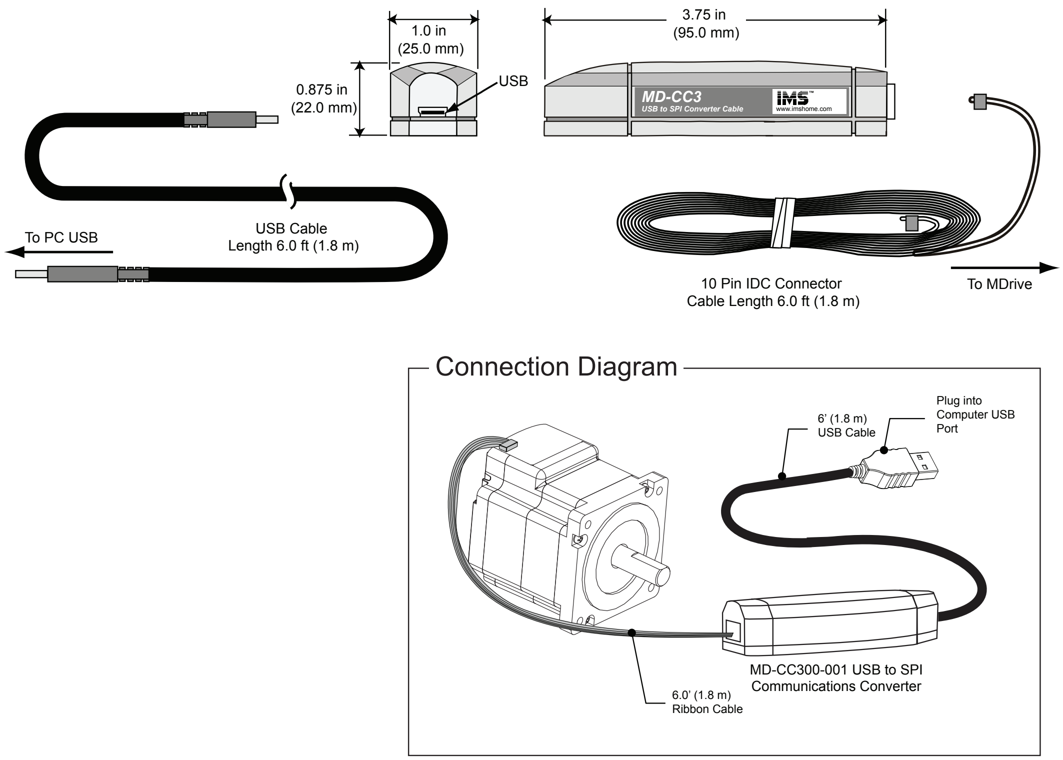


Figure C.1: MD-CC300-001 Mechanical Specifications and Connection

N Note: Interactive installation tutorials are available at the IMS Web Site at http://www.imshome.com/tutorials.html

Connector Detail and Mating Connector Kit

Should you choose to create your own interface cable IMS now has mating connector kits available which assist you in creating interface cables in small quantities. These kits come with the connector shells and crimp pins (if applicable) to create five interface cables.

Connector Details

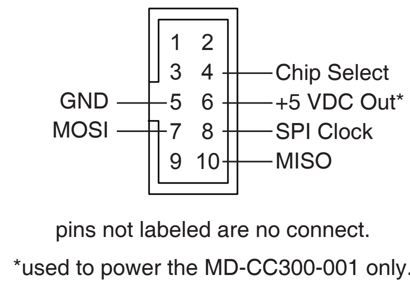


Figure C.2: 10-Pin IDC

Mating Connector Kit p/n: CK-01

Description:	5 mating connector shells for making interface cables to MDrive's 10-pin IDC connector. 2-piece connector shell crimps onto a 10 conductor AMP ribbon cable. Ribbon Cable is not included.	
IDC Parts:	Shell:	SAMTEC TCSD-05-01-N
	Ribbon Cable:	AMP 1-57051-9

MD-CC303-001

The MD-CC3030-001 interfaces to the model MDrivePlus Microstepping with a 12-Pin locking wire crimp type connector at location P1. This cable consists of two joined cables:

1. 6' (1.8m) RJ-45 Cable which plugs into the RJ-45 Jack of the converter body.
2. 13' (4.0 m) for I/O and Power connection.

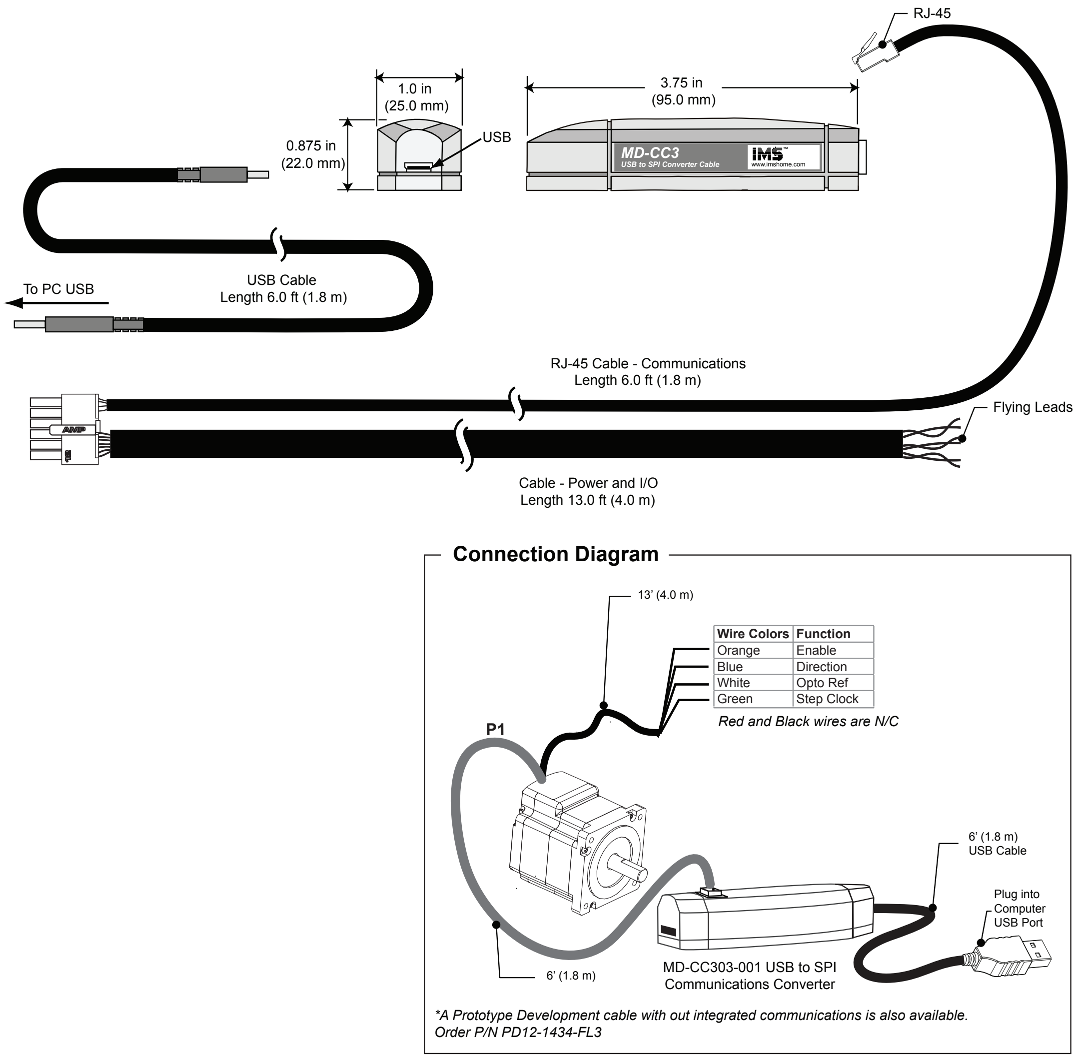


Figure C.3: MD-CC303-001 Mechanical Specifications and Connection

Connector Detail and Mating Connector Kit

Should you choose to create your own interface cable IMS now has mating connector kits available which assist you in creating interface cables in small quantities. These kits come with the connector shells and crimp pins to create five interface cables.

Connector Details

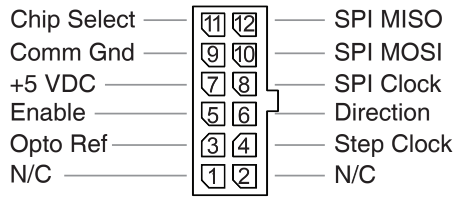


Figure C.4: 12-Pin Wire Crimp

Mating Connector Kit p/n: CK-03

Description:	5 mating connector shells and crimp pins. Recommend Tyco Crimp tool (Not included).	
Tyco Parts:	Shell:	1-794617-2
	Pins:	794610-1
	Crimp Tool:	91501-1

Installation Procedure for the MD-CC30x-000

These Installation procedures are written for Microsoft Windows XP Service Pack 2 or greater.

The installation of the MD-CC30x-001 requires the installation of two sets of drivers, which may be downloaded from http://www.imshome.com:

- Drivers for the IMS USB to SPI Converter Hardware.
- Drivers for the Virtual Communications Port (VCP) used to communicate to your IMS Product.

Therefore the Hardware Update wizard will run twice during the installation process.

The full installation procedure will be a two-part process: Installing the Cable/VCP drivers and Determining the Virtual COM Port used.

Installing the Cable/VCP Drivers

1) Download dirvers from http://www.imshome.com/cable_drivers.html.
2) Extract the driver files from the *.zip archive, remember the extracted location.
3) Plug the USB Converter Cable into the USB port of the MD-CC30x-001.
4) Plug the other end of the USB cable into an open USB port on your PC.
5) Your PC will recognize the new hardware and open the Hardware Update dialog.
6) Select "No, not this time" on the radio buttons in answer to the query "Can Windows Connect to Windows Update to search for software?" Click "Next" (Figure C.5).
7) Select "Install from a list or specific location (Advanced)" on the radio buttons in answer to the query

Figure C.5: Hardware Update Wizard

"What do you want the wizard to do?" Click "Next" (Figure C.6).

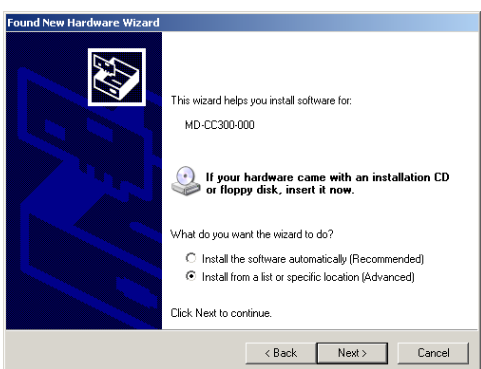


Figure C.6: Hardware Update Wizard Screen 2

86) Select “Search for the best driver in these locations.”
(a) Check “Include this location in the search.”
(b) Browse to the location where you extracted the files in Step #2.
(c) Click Next (Figure C.7).

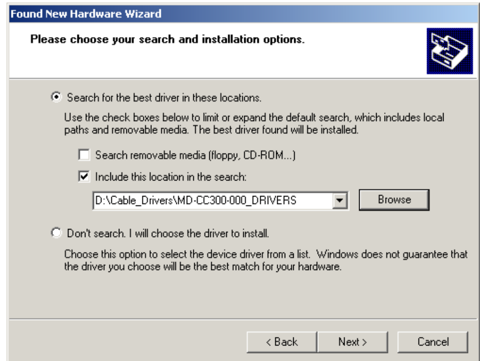


Figure C.7: Hardware Update Wizard Screen 3

9) The drivers will begin to copy.

10) On the Dialog for Windows Logo Compatibility Testing, click “Continue Anyway” (Figure C.8).

11) The Driver Installation will proceed. When the Completing the Found New Hardware Wizard dialog

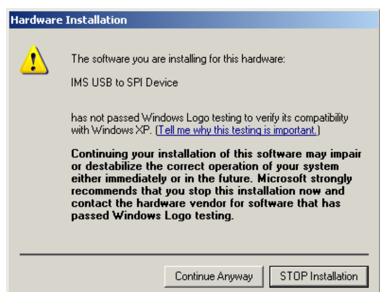


Figure C.8: Windows Logo Compatibility Testing

appears, Click “Finish” (Figure C.9).

Figure C.9: Hardware Update Wizard Finish Installation

12) Upon finish, the Welcome to the Hardware Update Wizard will reappear to guide you through the second part of the install process. Repeat steps 3 through 11 above to complete the cable installation.

11) Your IMS MD-CC30x-001 is now ready to use.

Determining the Virtual COM Port (VCP)

The MD-CC30x-001 uses a Virtual COM Port to communicate through the USB port to the MDrive. A VCP is a software driven serial port which emulates a hardware port in Windows.

The drivers for the MD-CC30x-001 will automatically assign a VCP to the device during installation. The VCP port number will be needed when IMS Terminal is set up in order that IMS Terminal will know where to find and communicate with your IMS Product.

To locate the Virtual COM Port.

1) Right-Click the "My Computer" Icon and select "Properties".
2) Browse to the Hardware Tab (Figure D.9), Click the Button labeled "Device Manager".
3) Look in the heading "Ports (COM & LPT)" IMS USB to SPI Converter Cable (COMx) will be listed (Figure D.10). The COM # will be the Virtual COM Port connected. You will enter this number into your IMS SPI Motor Interface Configuration.

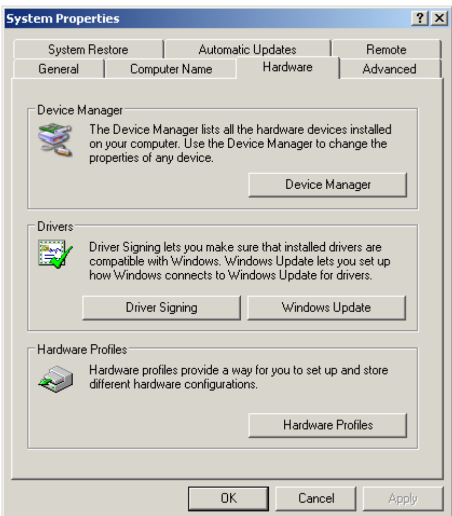


Figure C.10: Hardware Properties

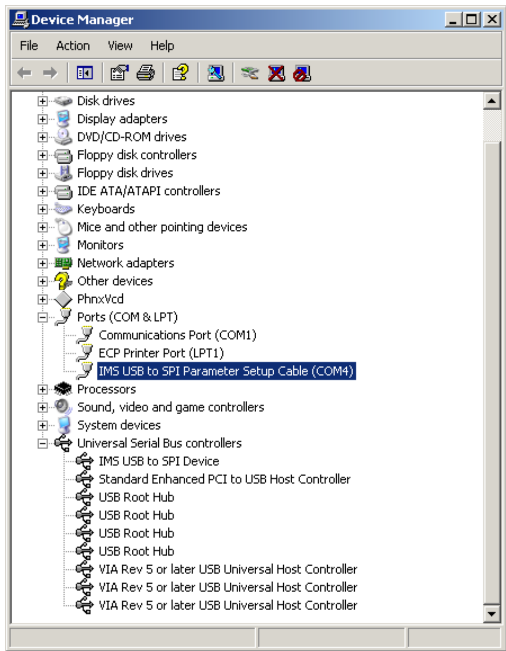


Figure C.11: Windows Device Manager

Prototype Development Cable PD12-1434-FL3

Wire Color Code			
Pair Number (Cable/Pair)	Color Combination	Interface Signal	MDrive Wire Crimp Connection Pin Number
1/1	White/Blue	Opto Reference	3
	Blue/White	Step Clock	4
1/2	White/Orange	Enable	5
	Orange/White	Direction	6
1/3	White/Green	SPI Clock	8
	Green/White	COMM GND	9
1/4	White/Brown	+5VDC	7
	Brown/White	Master In - Slave Out	12
1/5	White/Gray	Master Out - Slave In	10
	Gray//White	SPI Chip Select	11
2/1	Black	N/C	1
	Red	N/C	2

Table C.1: PD10-1434-FL3 Wire Color Codes

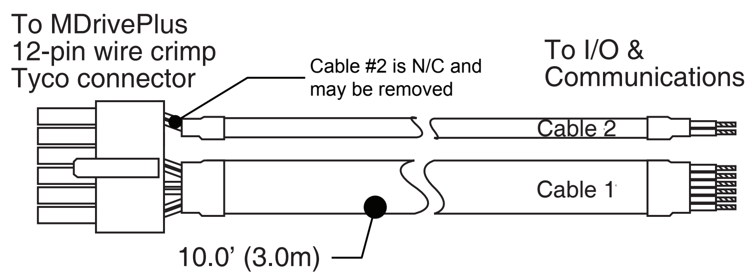


Figure C.12: PD12-1434-FL3

Connector Detail and Mating Connector Kit

Should you choose to create your own interface cable IMS now has mating connector kits available which assist you in creating interface cables in small quantities. These kits come with the connector shells and crimp pins to create five interface cables.

Connector Details

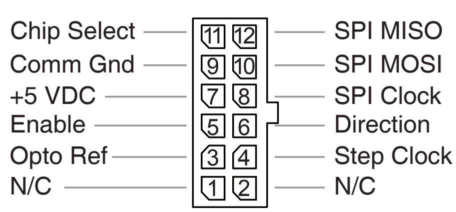


Figure C.13: 12-Pin Wire Crimp

Mating Connector Kit p/n: CK-03

Description: 5 mating connector shells and crimp pins. Recommend Tyco Crimp tool (Not included).

Tyco Parts:	Shell:	1-794617-2
	Pins:	794610-1
	Crimp Tool:	91501-1

PD10-3400-FL3 - Internal Differential Encoder

The PD10-3400-FL3 is a 10' (3.0 M) Prototype Development Cable used to interface the encoder signals to the user's controller. The Connector end plugs into the P4 Connector of the MDrive34Plus. The Flying Lead end connects to a Control Interface such as a PLC.

Wire Color Code			
Pair Number (Cable/Pair)	Color Combination	Interface Signal	MDrive Wire Crimp Connection Pin Number
1/1	White/Blue	Index +	6
	Blue/White	Index –	7
1/2	White/Orange	Channel B +	4
	Orange/White	Channel B –	5
1/3	White/Green	Channel A +	2
	Green/White	Channel B –	3
1/4	White/Brown	Ground	1
	Brown/White	+5 VDC Input	8

Table C.2: PD10-3400-FL3 Wire Color Codes

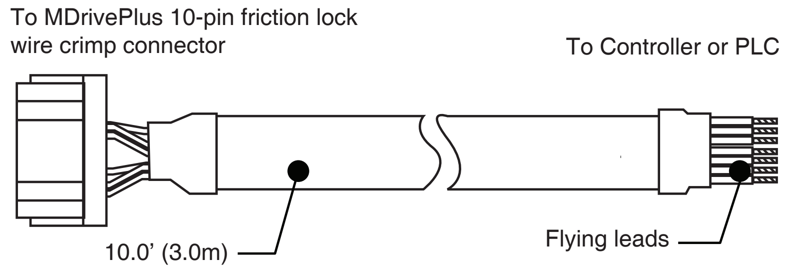


Figure C.14: PD10-3400-FL3

Connector Detail and Mating Connector Kit

Should you choose to create your own interface cable IMS now has mating connector kits available which assist you in creating interface cables in small quantities. These kits come with the connector shells and crimp pins to create five interface cables.

Connector Details

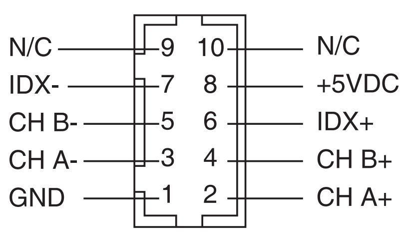


Figure C.15: PD10-3400-FL3

Mating Connector Kit p/n: CK-02

Description: 5 mating connector shells and crimp pins. Recommend Hirose Crimp tool (Not included).

Hirose Parts:	Shell:	DF11-10DS-2C
	Pins:	DF11-2428SC
	Crimp Tool:	DF11-TA2428HC

Prototype Development Cable PD02-3400-FL3 — Main Power

IMS recommends the Prototype Development Cable PD02-3400-FL3 for interfacing power to the MDrive-34Plus[2] Motion Control.

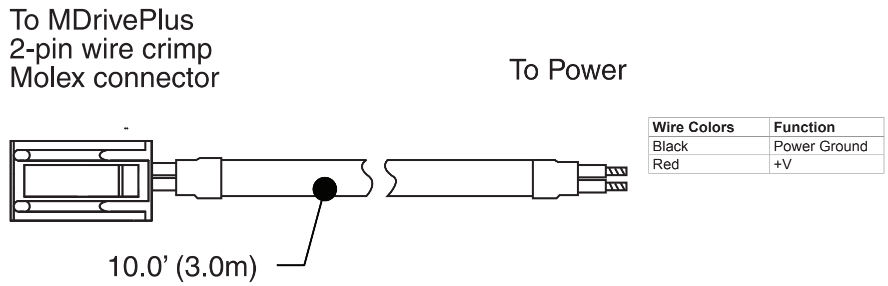


Figure C.16: PD02-3400-FL3

Connector Details

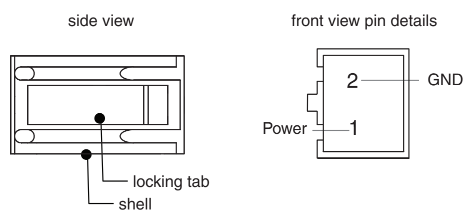


Figure C.17: 2-Pin Wire Crimp

Mating Connector Kit p/n: CK-05

Description: 5 mating connector shells and crimp pins. Recommend Molex Crimp tool (Not included).

Molex Parts:	Shell:	510-67-0200
	Pins:	502-17-9101
	Crimp Tool:	63811-1200

Interfacing an Encoder

Factory Mounted Internal Encoder

The MDrivePlus Microstepping are available with a factory-mounted internal optical encoder. See Table E.1 for available line counts. Encoders are available in both single-end and differential configurations. All encoders have an index mark.

Use of the encoder feedback feature of this product requires a controller such as an IMS MicroLYNX or PLC.

The encoder has a 100 kHz maximum output frequency.

	DIFFERENTIAL ENCODER	SINGLE-END ENCODER
Line Count	Part Number	Part Number
100	EA	E1
200	EB	E2
250	EC	E3
256	EW	EP
400	ED	E4
500	EH	E5
512	EX	EQ
1000	EJ	E6
1024	EY	ER

Table D.1: Available Encoder Line Counts and Part Numbers

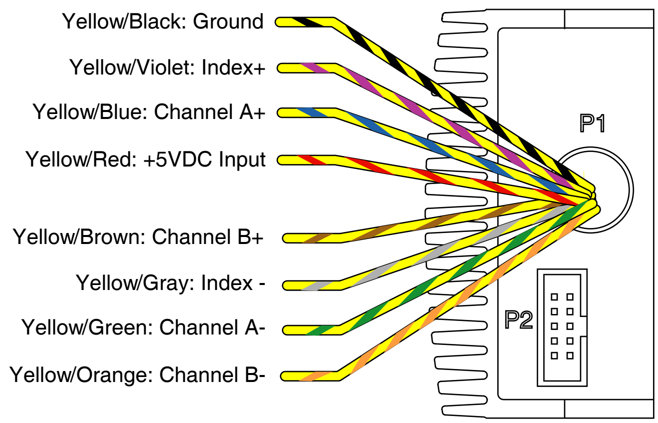
Note: The MDrive34Plus with Pluggable Interface is available with Differential Encoder only. The MDrive34Plus with Flying Leads is available with both Single-End or Differential Encoder.

General Specifications

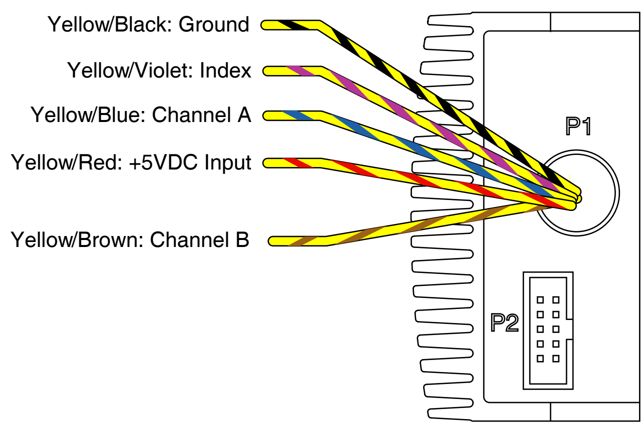
	Min	Typ	Max	Units
Supply Voltage (VDC)	-0.5		7	Volts
Supply Current	30	57	85	mA
Output Voltage	-0.5		Vcc	Volts
Output Current (Per Channel)	-1.0		5	mA
Maximum Frequency				100kHz
Inertia				0.565 g-cm^2 (8.0 x 10^{-6} oz-in-sec^2)
Temperature				
Operating				-40 to +100° C
Storage				-40 to +100° C
Humidity				90% (non-condensing)

Encoder Connections

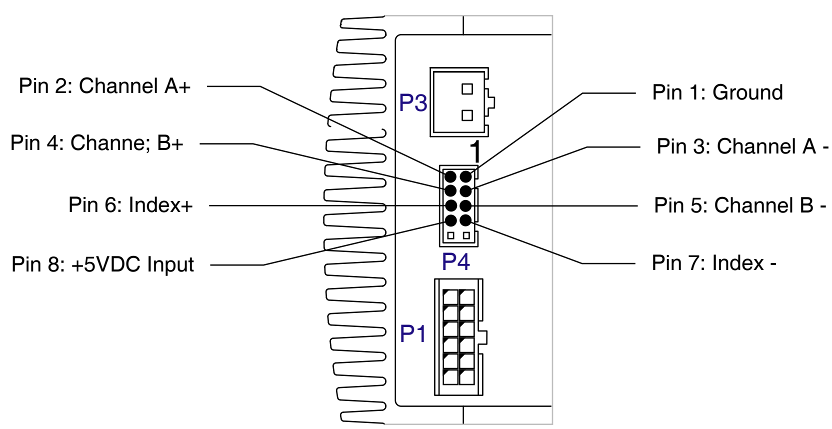
N Note: The MDM34 with Pluggable Interface is only available with a differential encoder.



Differental Encoder
Flying Leads



Single-End Encoder
Flying Leads



Differental Encoder
Pluggable Interface

Figure D.1: Single-End and Differential Encoder Connections

Encoder Signals

Single-End Encoder (Available with Flying Leads Version only)

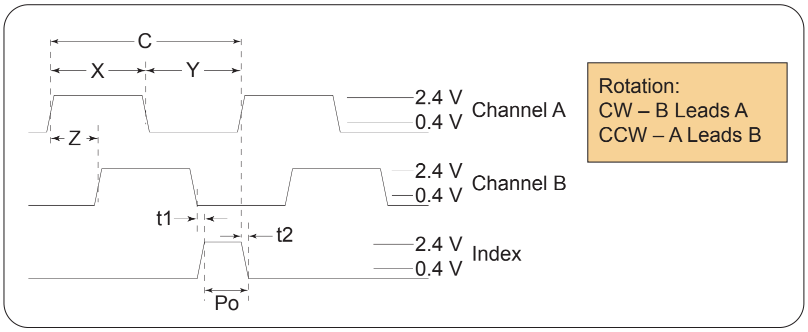


Figure D.2: Single-End Encoder Signal Timing

Differential Encoder

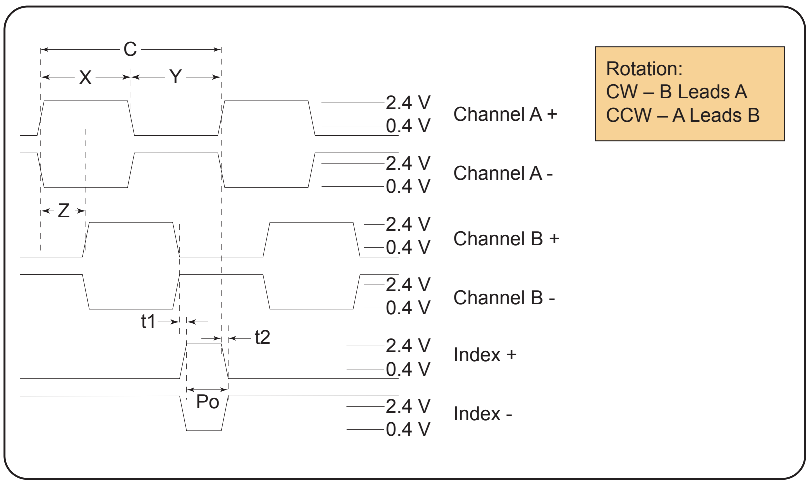


Figure D.3: Differential Encoder Signal Timing

Note: Rotation is as viewed from the cover side.

(C) One Cycle: 360 electrical degrees (°e)

(X/Y) Symmetry: A measure of the relationship between X and Y, nominally 180°e.

(Z) Quadrature: The phase lag or lead between channels A and B, nominally 90°e.

(Po) Index Pulse Width: Nominally 90°e.

Characteristics

Parameter	Symbol	Min	Typ	Max	Units
Cycle Error			3	5.5	°e
Symmetry		130	180	230	°e
Quadrature		40	90	140	°e
Index Pulse Width	Po	60	90	120	°e
Index Rise After CH B or CH A fall	t1	-300	100	250	ns
Index Fall After CH A or CH B rise	t2	70	150	1000	ns

Over recommended operating range. Values are for worst error over a full rotation.

Encoder Cable

IMS offers an assembled cable for use with the Differential Encoder on MDM34 with the Pluggable Locking Wire Crimp interface . The IMS Part Number is listed below.

Differential Encoder Cable (10' leads).. PD10-3400-FL3

Recommended Encoder Mating Connectors

IMS recommends the following mating connectors (or equivalent) if you make your own cables.

Differential Encoder

10-Pin Friction Lock Wire Crimp...Hirose DF11-10DS-2C

Pins

22 AWG .... Hirose DF11-22SC
24/28 AWG .... Hirose DF11-2428SC
30 AWG .... Hirose DF11-30SC

Linear Slide Option

Features

- Screw driven slide offering exceptional linear speed, accurate positioning and long life at a compelling value
- High bidirectional repeatability of up to 50 micro-inches (1.25 microns)
- Positional lead accuracy of 0.0006"/in. – accuracies to 0.0001"/in. available
- Linear speeds not limited by critical screw speed
- Standard leads:
  - 0.10" travel per revolution
  - 0.20" travel per revolution
  - 0.50" travel per revolution
  - 1.00" travel per revolution
- Achieve speeds that exceed 60.0"/second while offering excellent repeatability, accuracy and axial stiffness
- Optional sensor flag kit available for home, limits and general purpose inputs
- Assembly includes a precision aluminum guide and carriage which is driven by a precision rolled stainless steel lead screw
- Sliding contact areas coated with TFE (Teflon) permanent lubrication to offer a low 0.09 coefficient of friction
- Exceptional torsional stiffness and stability
- Standard lengths from 12.0" to 42.0", longer sizes available upon request
- Comes standard with wear-compensating, anti-backlash driven carriage
- Additional passive carriages or slides available to support cantilevered loads
- Easily mountable with provided mounting flange and holes
- Extrusions provided for sensor mounts

MDrive34Plus Linear Slide

Speed-Force Limitations†

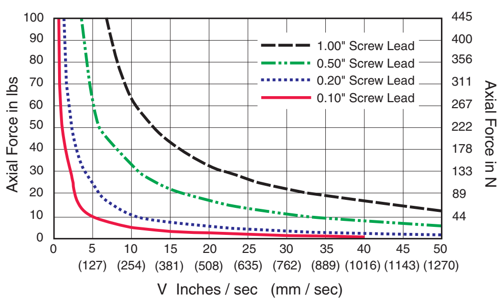


Figure E.1: Speed Force Limitations

†Speed/Force correlating equations:

1 Axial Force = $F_{friction} + F_{acceleration} + F_{gravity}$

$F_{friction}$ = (Weight)(0.09)

$F_{acceleration}$ = (Weight)(Acceleration) / Accel. of gravity

$F_{gravity}$ = 0 for horizontal application and 1 Weight for vertical application

2 $$\text{Torque} = \frac{(\text{Axial Force})(\text{Screw Lead})}{(0.393)(\text{Screw Efficiency})}$$

Force in lbs; Torque in oz-in, Lead in inches/rev

3 $$\frac{\text{Full Steps}}{\text{Second}} = \frac{(200\ \text{Full Steps/Rev})(\text{Velocity})}{\text{Lead}}$$

Lead in inches/rev; Velocity in inches/second

Speed-Torque Curves

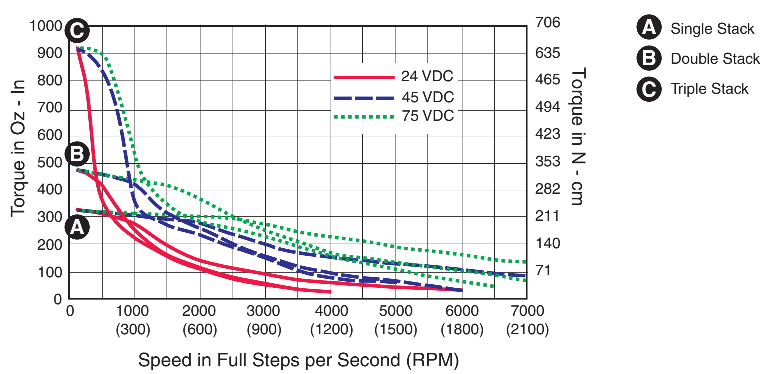


Figure E2: MDrive34Plus Speed Torque Curves

Specifications

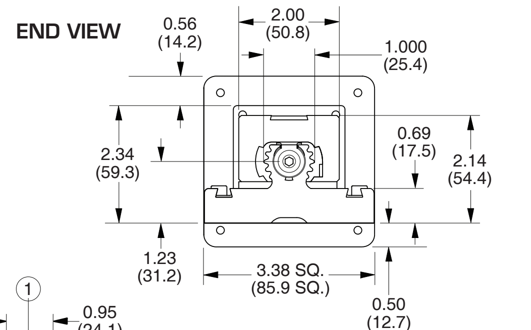
Screw Lead	Screw Efficiency	Nom. Screw Diam.	Inch Lead	Max Drag Torque	Life @ ¼ Design Load	Torque to Move Load	Axial Design Load	Screw Inertia
	%	inches (mm)	inches (mm)	oz inch (Nm)	inches (cm)	oz inch/lb (Nm/kg)	lbs (kg)	oz.in.sec^2/inch (Kgm^2/m)
0.10"	40	0.625 (15.9)	0.100 (2.54)	5.0 (0.04)	100,000,000 (254,000,000)	1.3 (0.020)	100 (46)	14.2 x 10^{-5} (3.9 x 10^{-5})
0.20"	53	0.625 (15.9)	0.200 (5.08)	6.0 (0.04)	100,000,000 (254,000,000)	2.0 (0.031)	100 (46)	14.2 x 10^{-5} (3.9 x 10^{-5})
0.50"	76	0.625 (15.9)	0.500 (12.70)	7.0 (0.05)	100,000,000 (254,000,000)	3.0 (0.047)	100 (46)	14.2 x 10^{-5} (3.9 x 10^{-5})
1.00"	81	0.625 (15.9)	1.000 (25.40)	8.5 (0.06)	100,000,000 (254,000,000)	6.5 (0.101)	100 (46)	14.2 x 10^{-5} (3.9 x 10^{-5})

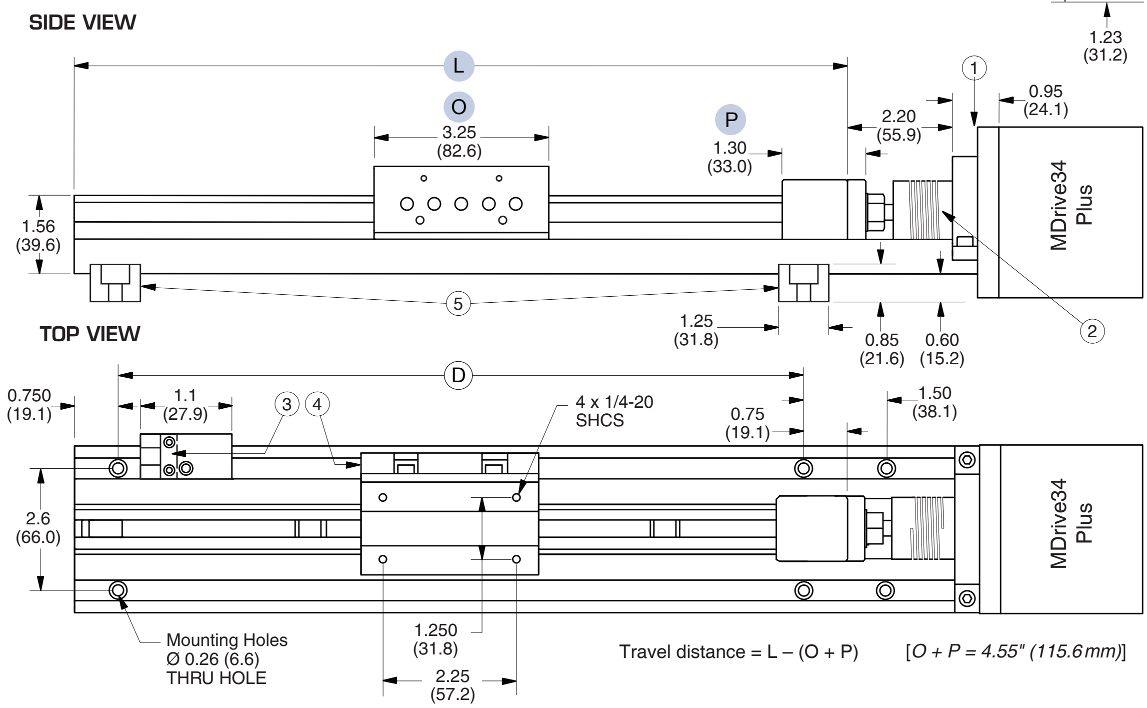
Table E.1: MDrive34Plus Linear Slide Specifications

Mechanical Specifications

Dimensions in Inches (mm)

1 Motor Mounting Plate
2 Heli-Cal Coupling
3 Sunx P/N PM-L24 sensor or equivalent *(not supplied)*
4 Optional Sensor Flag Kit for use with U-channel sensor *(details below)*





Mounting Holes

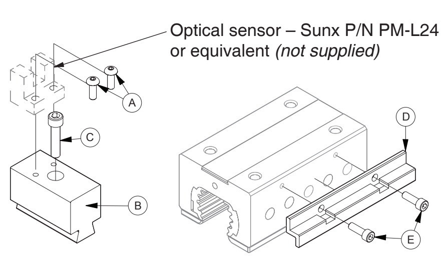
Slide Length (L)	Max Hole Distance (D)	Extra Hole Sets *(not shown)*	Equal Space Between Holes
12"	10.5"	none	10.5"
18"	16.5"	1	8.25"
24"	22.5"	2	7.5"
36"	34.5"	2	11.5"
42"	40.5"	2	13.5"

Travel distance = L – (O + P) [*O + P = 4.55" (115.6 mm)*]

Sensor Flag Kit Option

P/N RSM10-K Includes:

A #2-56 X 1/4" Long BHCS (6)
B Sensor Holder (3)
C #4-40 X 1/2" Long SHCS (3)
D Flag for Optical Sensor (1)
E #6-32 X 1/2" Long SHCS (2)



Mounting Bracket Kit Option

P/N RMB10-K Includes:

F Mounting Bracket (2)
G #1/4-20 X 3/4" Long SHCS (4)

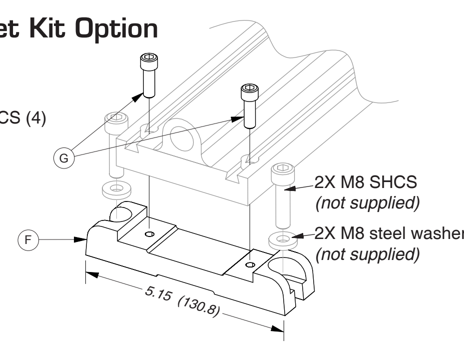


Figure F.3: Mechanical Specifications

WARRANTY

TWENTY-FOUR (24) MONTH LIMITED WARRANTY

Intelligent Motion Systems, Inc. (“IMS”), warrants only to the purchaser of the Product from IMS (the “Customer”) that the product purchased from IMS (the “Product”) will be free from defects in materials and workmanship under the normal use and service for which the Product was designed for a period of 24 months from the date of purchase of the Product by the Customer. Customer’s exclusive remedy under this Limited Warranty shall be the repair or replacement, at Company’s sole option, of the Product, or any part of the Product, determined by IMS to be defective. In order to exercise its warranty rights, Customer must notify Company in accordance with the instructions described under the heading “Obtaining Warranty Service.”

This Limited Warranty does not extend to any Product damaged by reason of alteration, accident, abuse, neglect or misuse or improper or inadequate handling; improper or inadequate wiring utilized or installed in connection with the Product; installation, operation or use of the Product not made in strict accordance with the specifications and written instructions provided by IMS; use of the Product for any purpose other than those for which it was designed; ordinary wear and tear; disasters or Acts of God; unauthorized attachments, alterations or modifications to the Product; the misuse or failure of any item or equipment connected to the Product not supplied by IMS; improper maintenance or repair of the Product; or any other reason or event not caused by IMS.

IMS HEREBY DISCLAIMS ALL OTHER WARRANTIES, WHETHER WRITTEN OR ORAL, EXPRESS OR IMPLIED BY LAW OR OTHERWISE, INCLUDING WITHOUT LIMITATION, **ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE**. CUSTOMER’S SOLE REMEDY FOR ANY DEFECTIVE PRODUCT WILL BE AS STATED ABOVE, AND IN NO EVENT WILL THE IMS BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, SPECIAL OR INDIRECT DAMAGES IN CONNECTION WITH THE PRODUCT.

This Limited Warranty shall be void if the Customer fails to comply with all of the terms set forth in this Limited Warranty. This Limited Warranty is the sole warranty offered by IMS with respect to the Product. IMS does not assume any other liability in connection with the sale of the Product. No representative of IMS is authorized to extend this Limited Warranty or to change it in any manner whatsoever. No warranty applies to any party other than the original Customer.

IMS and its directors, officers, employees, subsidiaries and affiliates shall not be liable for any damages arising from any loss of equipment, loss or distortion of data, loss of time, loss or destruction of software or other property, loss of production or profits, overhead costs, claims of third parties, labor or materials, penalties or liquidated damages or punitive damages, whatsoever, whether based upon breach of warranty, breach of contract, negligence, strict liability or any other legal theory, or other losses or expenses incurred by the Customer or any third party.

OBTAINING WARRANTY SERVICE

Warranty service may obtained by a distributor, if the Product was purchased from IMS by a distributor, or by the Customer directly from IMS, if the Product was purchased directly from IMS. Prior to returning the Product for service, a Returned Material Authorization (RMA) number must be obtained. Complete the form at http://www.imshome.com/rma.html after which an RMA Authorization Form with RMA number will then be faxed to you. Any questions, contact IMS Customer Service (860) 295-6102.

Include a copy of the RMA Authorization Form, contact name and address, and any additional notes regarding the Product failure with shipment. Return Product in its original packaging, or packaged so it is protected against electrostatic discharge or physical damage in transit. The RMA number MUST appear on the box or packing slip. Send Product to: Intelligent Motion Systems, Inc., 370 N. Main Street, Marlborough, CT 06447.

Customer shall prepay shipping changes for Products returned to IMS for warranty service and IMS shall pay for return of Products to Customer by ground transportation. However, Customer shall pay all shipping charges, duties and taxes for Products returned to IMS from outside the United States.

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